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REPORT OF SURVEY ON
GUADALUPE RIVER AND ADJACENT STREAMS FOR
FLOOD CONTROL AND ALLIED PURPOSES
SANTA CLARA AND ALAMEDA COUNTIES, CALIFORNIA

AND APPENDICES

JANUARY 1968

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA

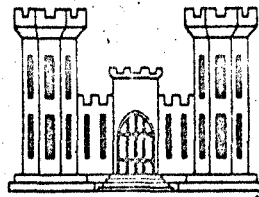
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TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	INTRODUCTION	1
1	AUTHORITY	1
2	PURPOSE AND EXTENT OF INVESTIGATION	2
3	SCOPE OF PRESENTATION	3
	PRIOR REPORTS	3
4	REPORTS BY THE CORPS OF ENGINEERS	3
7	REPORTS BY OTHER FEDERAL AGENCIES	4
8	REPORTS BY STATE AND LOCAL AGENCIES	5
	DESCRIPTION OF STUDY AREA	7
	ECONOMIC DEVELOPMENT	10
	CLIMATOLOGY	13
19	CLIMATE AND PRECIPITATION	13
20	RUNOFF AND STREAM-FLOW DATA	13

TABLE OF CONTENTS
(Continued)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	FLOODS	14
21	GENERAL	14
23	STANDARD PROJECT STORM AND FLOOD	16
	EXTENT OF CHARACTER OF FLOOD PLAIN	17
24	GUADALUPE RIVER FLOOD PLAIN	17
25	COYOTE CREEK FLOOD PLAIN	18
26	ADJACENT STREAMS FLOOD PLAINS	19
	FLOOD DAMAGES	19
27	HISTORICAL DAMAGES	19
28	AVERAGE ANNUAL DAMAGES	20
	EXISTING IMPROVEMENTS	21
	PROBLEMS UNDER INVESTIGATION	22
31	IMPROVEMENTS DESIRED	22
32	PHYSICAL PROBLEMS	23
33	ECONOMIC PROBLEMS	23
34	FLOOD PROBLEMS	24
35	WATER SUPPLY AND RECREATION	24
	SOLUTIONS CONSIDERED	24
36	GENERAL	24
37	GUADALUPE RIVER RESERVOIRS	25
39	COYOTE CREEK RESERVOIRS	27

TABLE OF CONTENTS
(Continued)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
40	INVESTIGATED PLAN OF IMPROVEMENT FOR GUADALUPE RIVER	27
41	INVESTIGATED PLAN OF IMPROVEMENT FOR COYOTE CREEK	28
42	INVESTIGATED PLAN OF IMPROVEMENT FOR ADJACENT STREAMS	29
	LOCAL COOPERATION	29
	LAND ENHANCEMENT	29
	FLOOD PLAIN MANAGEMENT	30
	DISCUSSION	30

TABLES

<u>Number</u>	<u>Subject</u>
1	DRAINAGE AREAS AND HYDROLOGICAL DATA
2	HYDROLOGIC DATA
3	RESERVOIRS IN GUADALUPE RIVER AND ADJACENT STREAMS STUDY AREA
4	COST AND BENEFITS OF CHANNEL WORKS & RESERVOIRS

PLATES

1	GENERAL PLAN OF BASIN
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TABLE OF CONTENTS
(Continued)

APPENDICES

<u>Number</u>	<u>Title</u>
A	HYDROLOGY AND HYDRAULIC ANALYSIS
B	FLOOD DAMAGES AND FLOOD CONTROL BENEFITS
C	ESTIMATES OF COST AND ANNUAL CHARGES

REPORT OF SURVEY
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1967

SYLLABUS

Guadalupe River and Adjacent Streams are located in the northern portion of Santa Clara County and a small part of southern Alameda County. The Guadalupe River flows through the city of San Jose. The adjacent stream flow through the cities of Santa Clara, San Jose, Sunnyvale, Mountain View and Milpitas. The entire area studied contains about 800 square miles.

The District Engineer finds that serious flood problems exist in the area and that future inundation damages are expected to average approximately ^{See p. 20} \$938,000 annually for the entire study area. He finds that flood protection by channel improvement and/or by reservoirs is not economically feasible. The total estimated average annual charges for the most likely plan of improvement, channel works on the Guadalupe River to give protection from the standard project flood would be \$1,700,000. The expected benefits from this improvement would be \$398,000 annually from reduction in flood damages and reduction in local bank protection expense. The ratio of expected average annual benefits to estimated average annual charges is 0.2 to ~~1.0~~. Estimated average annual charges for one percent chance flood protection would

be \$1,050,000, and corresponding annual benefits would be \$193,000. The ratio of benefits to cost would therefore be 0.2 to ~~1.0~~.

The District Engineer finds that the annual cost for standard project flood protection by channel works on Coyote Creek would be \$1,400,000 and that total annual benefits would be \$387,000. The ratio of benefits-to cost would be 0.3 ~~to 1.0~~. He finds that for the other adjacent streams, which have been considerably improved by Santa Clara County, the ratio of expected benefits to estimated cost of additional improvements in no case exceeds 0.2 to 1.0.

The District Engineer recommends that the United States not adopt a project for flood control and other allied purposes for the Guadalupe River and Adjacent Streams. ~~The District Engineer~~ concludes that local interests should be encouraged to institute flood plain management procedures to minimize flood losses. The District Engineer further recommends that responsible local interests be informed that, upon request, the Corps of Engineers can furnish substantial technical information, advice and assistance for establishing such flood plain management.



DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
100 McALLISTER STREET
SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO
SPNGP-WC

SUBJECT: Report of Survey on Guadalupe River and Adjacent Streams
for Flood Control and Allied Purposes in Santa Clara
and Alameda Counties, California

THRU: Division Engineer
U.S. Army Engineer Division, South Pacific
San Francisco, California

TO: Chief of Engineers
Department of the Army
Washington, D.C.

INTRODUCTION

1. AUTHORITY

A preliminary examination and survey of the Guadalupe River and tributaries, including adjacent streams, was authorized in the Flood Control Act of 18 August 1941 which reads, in part, as follows:

"Section 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas, the United States and its territorial possessions, which include the following-named localities:

"Coyote River and tributaries, California; San Francisquito Creek, San Mateo and Santa Clara Counties, California; Matadero Creek, Santa Clara County, California; and, Guadalupe River and tributaries, California."

The Chief of Engineers on 6 June 1945 authorized investigation of survey scope and combined all the streams draining into San Francisco

Bay south of the Dumbarton Narrows. This included the Guadalupe River, Coyote Creek, San Francisquito Creek, and numerous other creeks mentioned subsequently in this survey report to be reported on under the title of Guadalupe River and Adjacent Streams. The authorization for Coyote River was actually for Coyote Creek and is referred to hereinafter by its corrected designation. The survey was initiated in 1948 and suspended in 1950 due to drastic curtailment in funds. It was resumed in 1955. Following the severe storms of 1955-56, local interests at a public hearing on 7 February 1956 requested that first priority be given to completion of studies for flood control and allied purposes for the San Francisquito Creek, and this study was withdrawn and ^{is being} reported upon under its own authorization. Funds were allotted in fiscal year 1963 which permitted resumption of studies for Guadalupe River and Adjacent Streams.

2. PURPOSE AND EXTENT OF INVESTIGATION

The purpose of the investigation is to evaluate the water resources problems of the area with particular respect to determining the severity of flood problems. ^{The studies also included} /estimate of damages, alternative solutions, including allied purposes such as water supply and recreation, benefits, costs and economic justification. In pursuing this objective, field investigations and office studies were made in sufficient detail to determine the hydrological, hydraulic and economic aspects of the study area. Designs and costs of flood-control improvements were accomplished in sufficient detail and accuracy to permit determination of economic analyses and justification of the

X

various plans under consideration. During the investigation close coordination was maintained with the Santa Clara County Flood Control and Water District. Local agencies furnished information on topography, geology, sub-surface exploration, cross-sections of some streams, plans for future improvements, and other available technical data. The District Engineer made a personal reconnaissance of the areas involved.

3. SCOPE OF PRESENTATION

The scope of studies and the extent of information presented in this report and appendices are sufficient to support the conclusions and recommendations. Topographic surveys, site explorations and hydraulic studies were conducted for the major streams, namely Guadalupe River and Coyote Creek. On site field investigations were made to determine channel capacities on some of the smaller streams.

PRIOR REPORTS

4. REPORTS BY THE CORPS OF ENGINEERS

With the exception of the preliminary examination prepared for Matadero Creek in April 1942 and in connection with the subject authorization, there have been no previous

reports relating to flood control on Guadalupe River and Adjacent Streams by the Corps of Engineers. The preliminary examination indicated that a plan of improvement involving multiple-purpose storage reservoirs, channel improvements and bank-protection works would probably be economically justified.

5. Several navigation reports on Alviso Slough and ~~the~~ southern part of San Francisco Bay including the mouth of Guadalupe River have been submitted. None of these are of interest from the point of view of flood control. The two most recent, which are printed as House Document No. 279, 72d Congress, 1st Session, and Committee on Rivers and Harbors Document No. 8, 73d Congress, 1st Session, recommended a deep-water port in the southern end of the Bay under certain requirements of local cooperation. The project was authorized by the River and Harbor Act approved 30 August 1935 but the requirements of local cooperation were not met and no construction was done thereon. X

6. A Report of Survey for Flood Control and Allied Purposes, San Francisquito Creek, Santa Clara and San Mateo Counties, California, was prepared in January 1961. It was returned for updating and further analysis in view of local desires to develop a more acceptable alternative plan than the proposed multiple-purpose reservoir presented in the report. The reanalysis is currently in progress.

7. REPORTS BY OTHER FEDERAL AGENCIES

The Bureau of Reclamation prepared a report on the feasibility of water-supply development for the San Felipe Division of the Central

Valley Project, California, dated May 1963. The report on the San Felipe Division deals with the importation of water from Central Valley Project facilities to the Santa Clara Valley in Santa Clara and San Benito Counties, and the lower Pajaro River Basin in Santa Cruz and Monterey Counties. The Santa Clara Valley Flood Control and Water District has already contracted with the State of California to obtain up to ^{100,000} 88,000 acre-feet annually from the South Bay Aqueduct of the State of California's Water Project. The San Felipe diversion plan would allow for additional water to be imported into Santa Clara County by making use of the proposed north portion of the California Aqueduct to convey water from the Delta to the San Luis reservoir and through other features of the joint Federal-State San Luis unit to the Pacheco Tunnel out of the San Luis reservoir.

8. REPORTS BY STATE AND LOCAL AGENCIES

A report by the State of California, Department of Water Resources, Division of Resources Planning, Bulletin No. 3, The California Water Plan dated May 1957 discusses the possibilities of prospective local water resource developments in the Santa Clara Valley which would consist of a dam and reservoir on San Francisquito Creek, a well-field for the salvage of groundwater adjacent to Coyote Creek and a diversion canal from Calero reservoir to Los Gatos Creek to augment groundwater replenishment.

9. The State of California, State Water Resources Board, published a report entitled Bulletin No. 7, Santa Clara Valley Investigation,

dated June 1955. The report covered the water supply available in Santa Clara County and discussed plans for water resources development. Briefly, the report recommended that studies be initiated to determine the effects of recently completed water-development projects on the safe yield of groundwater basins in Santa Clara Valley, proceed with planned local projects for water-resource development as far as is practicable, and give early consideration to the implementation of plans for securing water supply from Feather River Project to supplement local supplies. The plans have since become a reality when in 1965 Santa Clara County contracted for water from the South Bay Aqueduct.

10. Engineer's report for Zone W-1, published by Santa Clara County Flood Control and Water District^{1/} dated 18 July 1962, is titled Proposed Water Treatment and Distribution System. The report contains a study of a basic primary water-distribution system consisting of 63 miles of pipeline and rapid, sand-filtration, water-treatment plants for the east and west sides of north Santa Clara Valley. The report suggests that portions of this system be coordinated with State construction to accept South Bay Aqueduct water at "Airpoint" in 1964. The reservoir was not constructed and water is taken directly from the aqueduct into the distribution system.

11. There were numerous reports published by local agencies including the Santa Clara County Flood Control and Water District and the Santa

^{1/} Formerly the Santa Clara Flood Control and Water Conservation District.

~~Clara Valley Water Conservation District. These reports concern them-~~
selves with flood control and water supply for the needs of local areas
within Santa Clara County. They have no bearing on the con-
clusions and recommendations reached in this report, and only serve to
indicate the length to which local interests have gone to provide water
~~supply and flood control without Federal assistance.~~

DESCRIPTION OF STUDY AREA

12. The area under consideration contains about 800 square miles,
and includes two major watersheds; namely, the Guadalupe River and
Coyote Creek and numerous smaller watersheds that drain into San
Francisco Bay ~~(see Plate I)~~. The area is highly urbanized and devel-
oped into residential, commercial and industrial uses. The principal
communities are San Jose, Santa Clara, Sunnyvale, Mountain View, Palo
Alto and Milpitas. The 1967 estimated population of the study area
is about 960,000. Major highways traversing the area are the Bayshore
Freeway (U.S. 101), El Camino Real, Nimitz Freeway (California State
Highway 17), Interstate 280, and the San Jose-Santa Cruz Highway
(California State Highway 17). The Southern Pacific Company railroad
and Western Pacific Railroad traverse the study area and pass through
the historic flood plains. The Guadalupe River drains an area of about
160 square miles at its mouth. The Coyote Creek basin drains about
420 square miles at its mouth. Streams in the western portion of the
study area are: Matadero, Adobe, Barron, Permanente, Stevens, Calabazas,
Saratoga and San Tomas Aquinas Creeks, all of which originate on the
northeastern slope of the Santa Cruz Mountains. Streams in southern

Alameda County that flow into San Francisco Bay are: Mission Creek, Canada del Aliso, Newark Slough, Plummer Creek and Mowry Slough. Tributaries to Coyote Creek originating in Alameda County are: Agua Caliente, Agua Fria, Torges and Scott Creeks. Tributaries to Coyote Creek draining the eastern slopes of the basin and originating in Santa Clara County are: Calera, Arroyo de los Coches, Lower Penitencia, Miguelita, Silver, Babb, South Babb, Thompson, Yerba Buena, Arroyo Aguague, Dry, San Felipe, Las Animas, Kelly Cabin, Grizzly, Canada de los Osos, Packwood and Middle, East and South Forks of Coyote Creek. Fisher Creek enters Coyote Creek from the western slope of the basin. The largest tributary to Guadalupe River is Los Gatos Creek which originates on the eastern slope of the Santa Cruz Mountains and makes its confluence with the Guadalupe River in San Jose. Other tributaries of the Guadalupe River are Dry, Canoas, Guadalupe, Alamitos, Rincon, Los Capitancillos and Arroyo Calero Creeks, all of which have their origins on the northern slopes of the Santa Cruz Mountains. In general, all streams have steep gradients: (two percent) in the upper reaches, relatively flat ones in the intermediate and lower reaches (0.5 percent) and tidal sloughs at the outlets (0.05 percent). Drainage areas of streams are in Table I.

TABLE 1

DRAINAGE AREAS AND HYDROLOGICAL DATA

Stream and Index Point	Drain- age Area (sq.mi.)	Normal Annual Precipi- tation (inches)	Standard Project Flood	
			Peak Discharge (c.f.s.)	
✓ Matadero Cr. at Palo Alto	7.2	18	2,200	$\frac{1}{1}$
✓ Baron Cr. at Bayshore Highway	3.5	19	1,600	$\frac{1}{1}$
✓ Adobe Cr. at Bayshore Highway	9.9	20	3,200	$\frac{1}{1}$
✓ Permanente Cr. at Bayshore Highway	17	22	4,500	$\frac{1}{1}$
✓ Stevens Cr. at Bayshore Highway	25	22	5,000	$\frac{1}{1}$
✓ Calabazas Cr. at Saratoga Cr.	13	20	3,500	$\frac{1}{1}$
✓ Saratoga Cr. at Saratoga	9.2	44	6,000	$\frac{1}{1}$
✓ San Tomas Aquinas Cr. at Stevens Creek Blvd.	19	19	4,600	$\frac{1}{1}$
Los Gatos Cr. at Lexington Dam	37	40	13,000	
Los Gatos Cr. at mouth	50	36	15,000	
Guadalupe Cr. at New Guadalupe Damsite	13	27	4,000	
Alamitos Cr. at mouth	35	26	9,400	
Canoas Cr. at mouth	23	15	2,100	
Guadalupe R. after junction Alamitos Cr.	53	26	14,000	
Guadalupe R. before junction Los Gatos Cr.	96	21	19,000	
✓ Guadalupe R. at San Jose	146	26	30,000	
Coyote Cr. at Coyote Dam	120	22	16,500	
Coyote Cr. at Anderson Dam	193	22	23,000	
Coyote Cr. at Edenvale	229	21	26,000	
Coyote Cr. at E. Julian St.	238	21	26,000	
Silver Cr. before junction Dry Cr.	7.3	14	1,000	
Dry Cr. at mouth	18	16	3,100	
Silver Cr. after junction Dry Cr.	25	16	4,100	
Silver Cr. at mouth	50	16	6,500	
Coyote Cr. after junction Silver Cr.	292	20	30,500	
Penitencia Cr. at King Rd.	23	21	4,300	
✓ Coyote Cr. after junction Penitencia Cr.	315	20	33,200	
✓ Berryessa Cr. at W.P.R.R.	8.6	17	1,700	

Σ 573.4 sq. mi.

1/ Reconnaissance quality estimates based on curves developed during San Francisco Bay and tributaries studies. No detailed hydrographs were computed.

X

TABLE 1
(CONTINUED)

DRAINAGE AREAS AND HYDROLOGICAL DATA

Stream and Index Point	Drain- age Area (sq.mi.)	Normal Annual Precipi- tation (inches)	Standard Project Flood	
			Peak Discharge (c.f.s.)	
Arroyo de los Coches at W.P.R.R.	7.6	17	1,700	
Calera Cr. at Abel Rd.	2.3	19	700	
Scott Cr. at Highway 17	1.1	17	300	
Coyote Cr. at Dixon Rd.	366	20	40,000	
Coyote Cr. and Guadalupe R.	580	21	56,000	

ECONOMIC DEVELOPMENT

13. The study area comprises the greater part of Santa Clara County and part of Alameda County. It embraces the drainage basins of the Guadalupe River, Coyote Creek, the common watershed of several streams in the hilly western part of Santa Clara County, identified as the Mountain View Area, and the southernmost part of Alameda County, identified as the Newark Area.

14. Population growth and economic development in the study area during the last 15 years have been extraordinary - even for the rapidly growing Bay Area. In that short time, a major portion of the drainage area has changed from a highly productive agrarian area to a specialized manufacturing center of national importance. The effect of this development is evidenced by the fact that total

personal income for Santa Clara County in 1947 was only six times greater than the market value of cash farm income, but by 1960, total personal income was 24 times greater. Low density suburban communities have become crowded towns with their own satellite communities stretching into the hills.

15. The most intensive economic activity is in the west central portion of the drainage area, in that part extending from the Bay southward past San Jose. During the 1950 decade, the population in Santa Clara County more than doubled, increasing from 292,000 in 1950 to 642,000 in 1960. About one-third of the total county population increase occurred in San Jose proper and another third occurred in three other established communities, namely, the city of Santa Clara (adjacent to San Jose), Sunnyvale and Mountain View (both northwest of San Jose). This growth has been fostered by two circumstances; first, by the emergence of the area as a major research and manufacturing center for "space-age hardware" and as a center of applied scientific research; and second, to a lesser degree, by the necessary extension of the San Francisco commutation pattern to the south.

16. Notwithstanding the veritable onslaught of urbanism on the study area's land mass, agriculture is still an important segment of the local economy. During the last five years, the annual market value of Santa Clara County's agricultural products averaged about 84 million dollars and presently more acreage is devoted to agriculture than any other use. The prime low-lying agricultural lands, mainly orchards, are located in the northern part of the Guadalupe Basin and

in the adjacent part of the western drainage areas. It is precisely these highly productive agricultural lands that are most rapidly being converted to urban use. In consequence, during each of the last four years, the value of cash farm income for Santa Clara County has declined at an annual average rate of 6 percent while that of California and the United States rose at annual average rates of 2.0 percent and 2.4 percent, respectively. Strong efforts are being made by local planners to retain the remaining agricultural lands intact to serve as greenbelts. However, notwithstanding these efforts, it is almost a foregone conclusion that agriculture will be almost completely displaced in the western drainage area and in most of the study area within 50 years. The only agriculture expected to survive will be some orchards and grazing in the low rolling portions of the Coyote Basin and vineyards southeast of Los Gatos in the Guadalupe Basin.

17. Most of the presently remaining agricultural acreage on the valley floor will be converted into residential tracts to accommodate the 1.9 million additional people who are expected to reside in the study area during the next 50 years.

18. It is believed that within 50 years, ultimate development will have occurred in the lands which border the southern extremity of San Francisco Bay and in a wide strip following Highway U.S. 101 and extending the length of the study area. The carrying capacity of the land may exceed the degree of development projected, but rising land values and will force extensive residential development into the hilly lands in the

Coyote Basin and particularly into the Mountain View area. Moreover, new heavy commercial and industrial development will push southward along U.S. 101 toward Morgan Hill. It is concluded that with or without improvements, approximately the same level of development will be reached in 50 years, ~~however, without flood control, land development will be somewhat slower and land values will be somewhat less.~~

CLIMATOLOGY

19. CLIMATE AND PRECIPITATION

~~The climatology is discussed in detail in Appendix A of this report.~~ The study area is bounded on the west by the Santa Cruz Mountains and on the east by the Mt. Hamilton Range. The lengths of streams range from a few miles for the smaller streams to a maximum of 75 miles for Coyote Creek. The climate of the area is typical of the entire San Francisco Bay Area with mild winters and pleasantly warm summers. Ninety percent of the rainfall occurs in the winter months, with about 20 percent normally occurring in January. The rainfall averages from 14 inches adjacent to San Francisco Bay to 50 inches in the mountainous area along the westerly basin boundary. Temperatures at San Jose range from an average high of 81 degrees Fahrenheit during the month of July to an average low of 49 degrees during the month of January.

20. RUNOFF AND STREAM-FLOW DATA

~~Details and analysis of significant runoff and stream-flow data are discussed in Appendix A.~~ Precipitation and stream-flow records

have been maintained from a very early date in the Santa Clara Valley. The earliest rainfall gage is located at San Jose with a continuous record extending back to 1874. Records of stream flow date back to 1902 when the gage on Coyote Creek near Madrone was installed. The gage has been maintained continuously except from 1913 through 1915. Records indicate that since 1940, the greatest runoff was 9,150 cubic feet per second for Guadalupe River and 5,750 cubic feet per second for Coyote Creek. This occurred during the flood of 1-4 April 1958. A list of hydrological data at gaging stations, showing drainage areas, rainfall, runoff and peak discharges is contained in Table 2.

FLOODS

21. GENERAL

Flood-producing storms have occurred within the study area every few years, and damage from flooding has become increasingly serious in recent years as a result of rapid urban development. Newspaper accounts mention notable flood damage during 1862, 1893, 1911 and 1919 for the study area, but very little statistical data are available. The March 1911 flood peak of 25,000 cubic feet per second is the maximum of record on Coyote Creek during the period of gage records near Madrone. There has been significant regulation in runoff due to the construction of Coyote Dam in 1936 and Anderson Dam in 1950, both of which are on Coyote Creek. Although the reservoirs formed by these dams are for water-supply purposes, some flood reduction occurs when these water-supply reservoirs are less than full prior to the occurrence of a flood. A major flood occurred in November 1950 but the resulting runoff in the downstream reaches of Coyote Creek was minor due to dry conditions and low storage in the reservoirs prior to the storm. Flood-producing storms have occurred during February 1940, April 1941, January 1952, December 1955 (most notable); April 1958 and

TABLE 2

Hydrologic Data
Major Storms Since 1940

Storm Dates	Rainfall at Selected Stations			Flood Runoff and Peak Discharge			
	San Jose (Inches)	Wrights (Inches)	Coyote Dam (Inches)	Coyote Creek 1/ nr Madrone (196 sq.mi.)	Guadalupe River at San Jose 1/ (146 sq.mi.)	Saratoga Creek at Saratoga (9.2 sq.mi.)	Katadero Creek nr Palo Alto (7.2 sq.mi.)
26-29 February 1940	2.61	11.55	4.35	2.3 in. 3,920 cfs	4.3 in. 8,680 cfs	7.0 in. 2,540 cfs	4.6 in. 2/ 600 cfs 2/
3-6 April 1941	1.36	4.68	2.08	1.5 in. 4,180 cfs	1.9 in. 6,330 cfs	3.1 in. 608 cfs	1.7 in. 2/ 550 cfs 2/
16-19 November 1950	2.56	14.37	3.46	1.1 in. 230 cfs	1.1 in. 2,730 cfs	2.5 in. 826 cfs	N.R.
10-13 January 1952	2.75	7.62	3.33	2.8 in. 65 cfs	3.9 in. 8,000 cfs	4.3 in. 1,430 cfs	N.R.
21-24 December 1955	3.55	16.64	7.87	3.1 in. 10 cfs	4.7 in. 5,570 cfs	6.0 in. 2,730 cfs	2.9 in. 854 cfs
1-4 April 1958	2.82	9.38	5.16	2.1 in. 5,750 cfs	4.1 in. 9,150 cfs	4.9 in. 772 cfs	2.7 in. 672 cfs
29 January - 1 February 1963	6.46	19.61	10.03	2.3 in. 10 cfs	5.6 in. 6,240 cfs	5.9 in. 1,160 cfs	1.5 in. 641 cfs

1/ Basin runoff in inches is adjusted to include change in storage of reservoirs. Peak discharge is that which was recorded under conditions at the time of storm occurrence.

2/ Estimated as equal to Los Trancos Creek at Stanford University.

N.R. - No record.

January 1963. Rainfall and runoff data at selected stations during these storms are presented in the Appendix on Hydrology and shown in Table 2.

22. The flood of 2 April 1958 resulted in the greatest discharge on the Guadalupe River at San Jose since records began in 1930. The peak discharge of 9,150 cubic feet per second occurred at a time when all of the upstream reservoirs were spilling. It is estimated that the peak flood runoff of December 1955 which was 5,570 cubic feet per second would have been about 17,000 cubic feet per second on the Guadalupe River at San Jose if the upstream reservoirs had not provided, in some cases, the complete or, in other cases, partial control of runoff. On Saratoga Creek the greatest flood of record occurred in December 1955 and the peak discharge was 2,730 cubic feet per second. Matadero Creek at Palo Alto also recorded its maximum discharge of 854 cubic feet per second during the December 1955 flood. All evidence indicates that the December 1955 storm and flood was the greatest of record on those basins which were not significantly affected by storage reservoirs. ~~Further discussion, tables and discharge hydrographs are presented in the Hydrology and Hydraulics Appendix to this report.~~

23. STANDARD PROJECT STORM AND FLOOD

The standard project flood is an estimated flood that might be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of this geographical region. The term "standard project storm" is used herein to denote the storm used to derive the standard project flood

and represents the most severe combination of meteorological and hydrological conditions reasonably characteristic of the region meteorologically homogenous with the area under study. The standard project flood is developed from the storm by assuming the storm is centered over the study basin with antecedent conditions favorable to runoff. The standard project flood is used as a basis of evaluating the degree of protection provided by a selected design discharge and establishes the upper limits for which flood protection will be sought in design of flood-control improvements. The 21-24 December 1955 storm has been adopted in this study as the standard project storm because it resulted in the largest peak discharge on Coyote Creek and Guadalupe River. This storm had its major center in the Hollister area about 40 miles south east of San Jose. ~~Standard project storm and flood peak discharge values for various points are given in tabular form in the Hydrology and Hydraulics Appendix to this report.~~ standard project flood The discharges for the lower reaches of Guadalupe River and Coyote Creek are 30,000 and 40,000 cubic feet per second respectively.

EXTENT OF CHARACTER OF FLOOD PLAIN

24. GUADALUPE RIVER FLOOD PLAIN

A portion of the lower Guadalupe River flood plain, and which includes the town of Alviso, is common with the Coyote Creek flood plain. Flooding in the upper reaches of all streams in the Guadalupe River Basin has been superficial with damages caused primarily by bank erosion due to high velocity of streamflow. In the lower reaches, major damage has occurred because of inadequate channel capacity, silting and debris accumulation. The Guadalupe River, for convenience of analysis, has

been divided into seven reaches. Reach I, from San Francisco Bay to Alviso, consists mostly of salt ponds and tidal and marsh lands. One line of the Southern Pacific Company railroad extends into this reach. Reach II, from Alviso upstream to Montague Road, has been an area of extensive flood damage in the past. A portion of the Agnews State Hospital (West) is located in this flood plain and has been subjected to flooding. Reach III, from Montague Road to Brokaw Road, includes a portion of the San Jose Municipal Airport. Reach IV, from Brokaw Road to Hamline Road, includes the balance of the San Jose Municipal Airport. Reach V, from Hamline Road to The Alameda, includes the major portion of downtown San Jose, Civic Center and City Hall. Reach VI, along the Guadalupe River from The Alameda to Branham Road, includes the Southern Pacific Company switchyards, the major industrial area of San Jose and the general residential area of Willow Glen and Robertsville. Reach VII along Los Gatos Creek, the main tributary of the Guadalupe, extends from The Alameda to the confluence of Dry Creek with Los Gatos Creek. This reach, although not subjected to extensive flooding, has had a history of bank erosion. The Guadalupe River Basin sustained over 6,000 acres of flooded land from the December 1955 flood, and 2,700 acres from the April 1958 flood. The standard project flood plain would cover 11,000 acres, of which about 3,000 acres could also be flooded by water from Coyote Creek.

25. COYOTE CREEK FLOOD PLAIN

A major portion of the lower Coyote Creek flood plain is common with the Guadalupe River flood plain. In fact the flood plain extends

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In Adjacent streams?
See next page

to the existing levees of the Guadalupe River from Alviso to Trimble Road. With the exception of the city of Alviso and the Agnews State Hospital (East), the area is mostly countryside and consists mainly of lands put to agricultural uses. In the reaches above The Alameda, the Coyote Creek flood plain narrows, includes a switchyard of the Western Pacific Railroad and consists mostly of agricultural lands. The flood plain extends from Cushing Road on the north to Story Road on the south. Coyote Creek Basin had 2,300 acres flooded from the flood of December 1955, and 2,340 acres from the April 1958 flood. The standard project flood plain would inundate an estimated 9,000 acres, of which about 3,000 acres could be flooded by water from Guadalupe River.

~~26.~~ ADJACENT STREAMS FLOOD PLAINS

The 1955 flood inundated nearly 9,000 acres in the study area composing the adjacent streams. This includes 100 acres for Matadero Creek, 4,200 acres for Saratoga Creek, 1,800 acres for San Tomas Aquinas Creek, 1,800 acres for Stevens Creek, 800 acres for Permanente Creek, 100 acres for Adobe Creek and over 400 acres for Calabazas Creek.

FLOOD DAMAGES

~~27.~~ HISTORICAL DAMAGES

Field surveys were made of the damages resulting from the floods of December 1955, April 1958 and January 1963. Damages covered industrial, commercial, residential, agricultural and public property. Damages were classified in accordance with these categories and summarized, giving a complete record and showing an overall effect.

Based on 1964 prices and conditions, the floods of December 1955 caused damages that totalled \$1,180,000 for the Guadalupe River Basin, \$136,000 for Coyote Creek basin, and \$2,570,000 for the adjacent streams. The floods of April 1958 caused \$1,600,000 for the Guadalupe River, \$365,000 for Coyote Creek and \$350,000 for the adjacent streams. ~~Detailed tables of the historical damages for the study are given in Appendix B, "Flood Damages and Flood-Control Benefits."~~

~~28. AVERAGE ANNUAL DAMAGES~~

~~A frequency curve was developed for each basin from existing records, historical reports, comparison of areas and runoff characteristics and correlations of recorded discharges. A discharge-damage curve was then prepared for each basin by plotting past damages adjusted to present economic conditions and prices. Adjusted historical damages were supplemented by estimates of damages that would be caused by floods of sizes other than those for which records are available. This procedure was used to extend the curves to include such floods as the standard project flood. The area under the damage-frequency curves, converted to its equivalent value in dollars, represents the average annual damages. The appropriate development factors are then applied to obtain values for future conditions.~~ The average annual damages, based on December 1967 prices and future conditions for 100-year economic project life are for the Guadalupe River Basin, \$436,000; for Coyote Creek Basin, \$425,000, and for the adjacent streams, \$121,000.

425
436,000 - Sup. 2
438,000 - Sup. 2

EXISTING IMPROVEMENTS

29. There are about 19 water supply reservoirs in the study area varying in capacity from less than 100 acre feet to over 90,000 acre feet, but none have allotted storage for flood control. Those constructed by the Santa Clara Valley Water Conservation District are used for percolation of water into the underground storage basin.

Table 3 is a list of these reservoirs, showing ownership, size and location by stream.

TABLE 3

RESERVOIRS IN GUADALUPE RIVER AND ADJACENT STREAMS STUDY AREA

Dam No.	Name of Reservoir	Stream	Maximum* storage capacity (acre-feet)	Owner
1	Cherry Flat	Upper Penitencia Creek	500	City of San Jose
2	Coyote Percol.	Coyote Creek	72	Santa Clara Valley WCD 1/
3	Coyote	Coyote Creek	24,500	Santa Clara Valley "
4	Calero	Calero Creek	9,600	Santa Clara Valley "
5	Almaden	Almaden Creek	2,000	Santa Clara Valley "
6	Guadalupe	Guadalupe Creek	3,500	Santa Clara Valley "
7	Vasona Percol.	Los Gatos Creek	750	Santa Clara Valley "
8	Stevens Creek	Stevens Creek	3,900	Santa Clara Valley "
9	Lexington	Los Gatos Creek	21,400	Santa Clara Valley "
10	Anderson	Coyote Creek	91,300	Santa Clara Valley WCD
11	Grant Company	Arroyo Aguague	600	Grant Ranch
12	Lake Ranch	Beardsley Creek	337	San Jose Water Works
13	Lower Howell	Rundell Creek	153	San Jose Water Works
14	Upper Howell	Rundell Creek	243	San Jose Water Works
15	Williams	Los Gatos Creek	160	San Jose Water Works
16	Austrian	Los Gatos Creek	6,200	San Jose Water Works
17	Kuhn	Trib. Dry Creek	85	Chas. B & Geo. B. Kuhn
18	Kelly Cabin Canyon	Kelly Cabin Canyon Creek	70	Frank R. Coit
19	San Felipe Ranch	Trib. San Felipe Creek	40	San Felipe Ranch

1/ Santa Clara Valley Water Conservation District

* Source: Bull. No. 17 - Dams Within Jurisdiction of the State of California - Department of Water Resources, July 1967 and information furnished by Santa Clara Valley Water Conservation District.

The underground water basin has been the primary source of water for domestic, industrial, and agricultural use in Santa Clara County. In recent years the heavy drain on water has caused a dangerous overdraft of the underground basin. Upstream reservoirs cannot provide enough percolation water to recharge the underground basin or surface storage to meet future demands. The solution to the problem is importation of water from outside the basin. The proposed San Felipe Project

~~discussed earlier in this report,~~ as well as the South Bay Aqueduct, a part of the California Water Project are possible solutions.

~~30.~~ No flood control improvements have been constructed by the Corps of Engineers in the area. The Santa Clara County Flood Control and Water District has spent over \$25,000,000 for flood control projects in the study area, as of 30 June 1966. They have constructed a channel of 12,500 cubic feet per second capacity on the Guadalupe River from the Bayshore Highway to El Dorado Street in Alviso at a cost of more than \$4,600,000. The levee setback and the right-of-way established was made to allow for a 25,000 cubic feet per second channel to be constructed in the second and ultimate stage of the District's flood control plans.

PROBLEMS UNDER INVESTIGATION

~~31.~~ IMPROVEMENTS DESIRED

In general, the improvements desired by local interests, as expressed in a public hearing on 27 September 1944 and subsequent public meetings, the latest of which was held in San Jose on 15 January 1963, are channel works and levees, with consideration of multiple-purpose

reservoirs for flood control, water supply and recreation. In preparation of this report local interests have given the Corps of Engineers their full cooperation as well as special assistance when requested.

32. PHYSICAL PROBLEMS

Land subsidence has occurred in the central reach of the Santa Clara Valley in an area of intensive groundwater use. Maximum subsidence for the twenty-year period of 1934 to 1954 was 4.06 feet in Sunnyvale. Subsidence in and around San Jose for the same period exceeded 3 feet in many places. Between 1956 and 1962 subsidence in San Jose was 1.7 feet. The Geological Survey and the Coast and Geodetic Survey are continuing subsidence investigations. The latest report of the Geological Survey released in June 1967 indicates that between 1960 and 1967 (actually 6-1/3 years) the maximum subsidence was 3.9 feet in southern San Jose. The report also relates excessive withdrawal of water from the underground aquifer with ^{causing} subsidence. A portion of the area is traversed by the San Andreas fault.

~~future reservoir construction to seismic considerations. Most of the~~
~~Those remaining~~
~~offer small potential for flood control and allied purposes.~~

33. ECONOMIC PROBLEMS

Inundation by overbank flows has been an economic problem to the community to the extent of the damages sustained by floods cited in a previous paragraphs, and the interruption of traffic during periods of flooding. The rapid growth of the area has caused development to take place in former agricultural areas that are in the flood plain.

34. FLOOD PROBLEMS

The problem of flooding of the Guadalupe River and its adjacent streams is one essentially caused by insufficient carrying capacity of the channels. When substantial runoff from the watershed enters the channel, the water overflows the bank and causes damages by inundating the surrounding areas. Two solutions of this problem were considered. First, an attempt to achieve flood control was made by study of storage upstream of the flooded areas. The second solution considered was increasing the channel capacity by widening and deepening, and by adding levees on the top of the banks to increase the carrying capacity of the channel. The effects of these solutions are discussed in subsequent paragraphs.

35. WATER SUPPLY AND RECREATION

The study area is increasing in population at such a dynamic rate that there is a pressing need for both water supply and recreation. The demand for these resources are brought about by a combination of increase in population and a more affluent society that has to utilize these resources. The solution considered for this problem was utilization of multiple-purpose reservoirs which would provide water supply and recreation as well as flood control. The result of these studies is discussed in subsequent paragraphs.

SOLUTIONS CONSIDERED

36. GENERAL

Plans were considered for reservoirs for both single purpose flood control and for multiple-purpose including recreation and

water supply and for improvement of all channels in the study area by widening and deepening, construction of levees, and bank protection work including floodwalls, concrete lining and open rectangular concrete conduits. Although no plan was found to economically feasible, the result of these studies are presented herein.

37. GUADALUPE RIVER RESERVOIRS

Since all the prime reservoir sites in the study area were occupied by local water-supply projects, cited previously, the only possible solution concerning reservoirs that presented itself was to utilize the existing reservoir sites and increase the capacity of such existing projects. Consideration was given to the possibility of increasing the capacity of the existing Lexington Reservoir on Los Gatos Creek. By increasing the storage capacity of Lexington Reservoir to provide 18,000 acre-feet of flood control storage, the standard project flood discharge below the confluence of Los Gatos Creek and the Guadalupe River would be reduced from 30,000 cubic feet per second to 18,000 cubic feet per second. This plan was found to be economically infeasible since the annual cost exceeded the annual benefits. The studies on the Lexington Reservoir also included recreation and additional water-supply benefits as well as providing for flood control in various combinations. No combination of these benefits gave a benefit to cost ratio in excess of unity. Additional water supply, either combined with flood control or as a single-purpose reservoir, was found to be economically infeasible in that the highest benefit to cost ratio obtained was 0.4 to 1.0. In this case, the first cost was 12 million dollars, the annual cost was \$553,000 and the annual benefits were \$203,000.

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Water supply benefits were based on the most likely least cost alternative cost which, in this case, was the proposed San Felipe Project of the U.S. Bureau of Reclamation. Water from this supply is expected to be available at about \$30 per acre-foot according to the report of the Bureau of Reclamation. A combined recreation and flood control reservoir resulted in a benefit-to-cost ratio of 0.4 to 1.0. The actual cost and benefit quantities varied in accordance with the capacity of the reservoir under study. The cost and benefits of various plans are included in Table 4.

TABLE 4
COST AND BENEFITS OF CHANNEL WORKS & RESERVOIRS
(Based on June 1967 prices)

Thousands of Dollars

Stream	Existing degree of protection (exceedence in- terval in years)	First cost ^{1/}	Standard Project Flood Protection		
			Annual cost	Annual benefit	Benefit-to- cost ratio
Guadalupe River	35	42,000	1,700	398	0.2
Lexington Reservoir		12,000	553	203	0.4
Coyote Creek	5	35,000	1,400	387	0.3
Mafadero Creek	100	3,100	126	0	0
Barron Creek	3	3,600	147	6	.03
Adobe Creek	15	3,700	150	11	.05
Permanente Creek	6	6,600	268	13	.03
Stevens Creek	100	9,100	368	58	.11
Calabazas Creek	30	8,300	336	10	.02
Saratoga Creek	60	13,400	542	18	.02
San Tomas Aquinas Cr.	100	8,900	360	5	.01

^{1/} Cost includes Real Estate and Relocations

38. Preliminary studies were made also to determine the feasibility of providing flood control storage on Guadalupe Creek at the new Guadalupe Dam site 3 miles below the existing Guadalupe Dam and at the existing Calero and Almaden conservation reservoirs. Due to small drainage areas controlled by these dams, the possible downstream reductions in flood peaks are too small to justify detailed studies.

39. COYOTE CREEK RESERVOIRS

Studies were made for increasing the existing capacity of Anderson Reservoir on Coyote Creek. Physical conditions at the dam limited the flood control storage available to 14,000 acre-feet which would provide protection for a flood of about 4 percent frequency. The total cost based on preliminary estimates would be about \$9,000,000. The annual cost would be about \$400,000 and annual benefits, \$162,000.

40. INVESTIGATED PLAN OF IMPROVEMENT FOR GUADALUPE RIVER

The most practical plan for improving the channel of Guadalupe River, including the lower reach of Los Gatos Creek, would provide protection against standard project flood peak discharge of 30,000 cubic feet per second downstream from the confluence of Los Gatos Creek. Upstream from the confluence of Los Gatos Creek to Canoas Creek on the Guadalupe River, ~~the~~ protection would be for 16,000 cubic feet per second discharge. From Canoas Creek to Branham Lane on the Guadalupe River, protection would be for a discharge of 14,000 cubic feet per second. On the lower reach of Los Gatos Creek to the confluence of Dry Creek, protection would be for a discharge of 14,000 cubic feet per second. The length of the project would be about 18 miles, and would consist of a trapezoidal channel in the lower reach with a bottom width of 400 feet

X

to a bottom width of 90 feet in the upper reach of the project. The plan is described in detail in Appendix A, Hydrology and Hydraulic Analysis. The cost of this plan is approximately \$42,000,000. The annual cost would be \$1,700,000 and the annual benefits derived for this plan of flood protection would be \$398,000. This results in a benefit-to-cost ratio of 0.2 to 1.0. A detailed cost estimate is included in Appendix C "Estimates of Costs and Annual Charges." Protection for the one percent chance flood discharge of 16,000 cubic feet per second, would cost \$24,000,000. Annual cost would be \$1,050,000, and annual benefits would be \$193,000 giving a benefit-to-cost ratio of 0.2 to 1.0. 170

41. INVESTIGATED PLAN OF IMPROVEMENT FOR COYOTE CREEK

The design discharge for Coyote Creek was based on the standard project flood. The plan of improvement would call for protection against a discharge of 40,000 cubic feet per second in the lower reach of Coyote Creek to 26,000 cubic feet per second near Story Road. The entire reach of the project would be approximately 12 miles. Twelve bridges would have to be replaced to satisfy the conditions of this plan. The total cost of the plan would be approximately \$35,000,000. The annual cost would be \$1,400,000 and the annual benefits would be \$387,000, resulting in a benefit-to-cost ratio of 0.3 to 1.0. A detailed cost estimate is included in Appendix C, "Estimate of Costs and Annual Charges." Protection against the one percent chance flood, a discharge of 19,000 cubic feet per second, would cost about \$20,000,000. The annual cost would be \$880,000 and the annual benefits would be \$320,000. The resulting benefit-to-cost ratio would be 0.4 to 1.0. N.B.

42. INVESTIGATED PLAN OF IMPROVEMENT FOR ADJACENT STREAMS

No detailed plan of improvement was studied for the adjacent streams. A field investigation was conducted to determine the need for possible flood control improvements on these streams. The Santa Clara County Flood Control and Water District has constructed the major part of the work that could be accomplished for these streams. In some cases the degree of protection is for a one percent chance flood. Increase in the protection on these streams to afford standard project flood protection was not found to be economically feasible. The results of the investigation are shown in Table 4. Since the small streams in the Newark Area, namely Newark Slough, Plummer Creek and Mowry Slough, had no history of significant flood damage, no field investigation was made for these streams.

LOCAL COOPERATION

43. Local interests have afforded full cooperation in the undertaking of this study. Local interests have been informed of the findings in these studies. Since the project is not economically justified there was no request made to fulfill the conditions of cooperation prescribed by law as in recommended projects.

~~LAND ENHANCEMENT~~

~~44. Indications are that there would be no land enhancement benefit in the study area attributable to any Federal flood control project. This has been demonstrated by the continual development taking place throughout the area. In addition to current trends, the county has a master plan which delineates future development. The plan calls for reservation of certain agricultural areas for park and recreation purposes in the vicinity of Alviso. Any higher utilization of this land would, therefore, be precluded.~~

DISCUSSION

The Guadalupe River and Coyote Creek have a common flood plain which can be inundated by waters from either the Guadalupe River or Coyote Creek or by both. In the evaluation of benefits consideration was given to this common flood plain. The frequency curve was adjusted to give recognition to the possibility that the worst storms could have occurred at a time when all existing water supply reservoirs were full. Even with this liberal interpretation of historical data, flood protection for both the Guadalupe River and for Coyote Creek was found not economically justified.

Channel improvements were made by Santa Clara County for most of the adjacent streams. These improvements have the effect of reducing future flood damages to such a degree that further major improvements would not be economically justified for these streams.

~~18.~~ The efforts by Santa Clara County to control flooding by channel improvements, combined with the effect of occasional storage in water percolation reservoirs constructed by the Santa Clara Valley Water Conservation District, has contributed to reducing flood damages for the study area that would have otherwise occurred.

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REPORT OF SURVEY
ON
GUADALUPE RIVER AND ADJACENT STREAMS
FOR
FLOOD CONTROL AND ALLIED PURPOSES

APPENDIX A

HYDROLOGY AND HYDRAULIC ANALYSES

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
GENERAL		
A-1	SCOPE	A-1
A-2	PRIOR REPORTS	A-2
A-3	BASIN DESCRIPTION AND CLIMATOLOGY	A-2
A-4	MAJOR STREAMS	A-3
HYDROLOGY		
A-5	RAINFALL AND STREAM GAGING STATIONS	A-4
A-6	EXISTING RESERVOIRS	A-5
A-7	MAJOR STORMS AND FLOODS	A-6
A-9	STANDARD PROJECT STORM AND FLOOD	A-8
A-10	FLOOD-CONTROL STORAGE REQUIREMENTS	A-11
A-11	EFFECT OF FLOOD-CONTROL STORAGE	A-13
	a. Hooker damsite	A-13
	b. Lexington Dam	A-14
	c. New Guadalupe damsite	A-14
	d. Anderson Dam	A-14
A-12	DISCHARGE FREQUENCY	A-15
A-13	WATER RESOURCES	A-17

TABLE OF CONTENTS
(continued)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
HYDRAULICS		
A-14	HYDRAULIC DESIGN CRITERIA	A-18
A-15	PRESENT CONDITIONS - GUADALUPE RIVER	A-19
A-18	FLOOD-CONTROL SOLUTIONS CONSIDERED - GUADALUPE RIVER	A-21
A-20	PLAN OF IMPROVEMENT - GUADALUPE RIVER	A-22
A-24	PRESENT CONDITIONS - COYOTE CREEK	A-25
A-25	FLOOD-CONTROL SOLUTIONS CONSIDERED - COYOTE CREEK	A-26
A-26	PLAN OF IMPROVEMENT - COYOTE CREEK	A-27
A-27	OTHER STREAMS	A-28
A-28	INTERIOR DRAINAGE	A-28

TABLES

A-1	HYDROLOGIC DATA - MAJOR STORMS SINCE 1940
A-2	ANNUAL MAXIMA DISCHARGES - TYPICAL OF UNREGULATED STREAMS
A-3	ANNUAL MAXIMA DISCHARGES - GUADALUPE RIVER AT SAN JOSE
A-4	ANNUAL MAXIMA DISCHARGES - COYOTE CREEK NEAR MADRONE
A-5	STANDARD PROJECT STORM RAINFALL DISTRIBUTION
A-6	HYDRAULIC DESIGN DATA

PLATES

A-1	NORMAL ANNUAL PRECIPITATION, 1906-56
A-2	DISCHARGE HYDROGRAPHS - DECEMBER 1955
A-3	DISCHARGE HYDROGRAPHS - APRIL 1958
A-4	ISOPERCENTUAL LINES

TABLE OF CONTENTS
(continued)

PLATES

A-5	DISCHARGE HYDROGRAPHS - STANDARD PROJECT FLOOD, GUADALUPE RIVER
A-6	DISCHARGE HYDROGRAPHS - STANDARD PROJECT FLOOD, COYOTE CREEK AND TRIBUTARIES
A-7	DISCHARGE-FREQUENCY, COYOTE CREEK AFTER JUNCTION WITH SILVER CREEK
A-7	DISCHARGE-FREQUENCY, SARATOGA CREEK AT SARATOGA
A-7	DISCHARGE-FREQUENCY, UPPER PENITENCIA CREEK AT SAN JOSE ✓
A-7	DISCHARGE-FREQUENCY, MATADERO CREEK AT PALO ALTO
A-7	DISCHARGE-FREQUENCY, GUADALUPE RIVER AT SAN JOSE
A-8	PLAN OF IMPROVEMENT - GUADALUPE RIVER
A-9	PROFILES AND DETAILS - GUADALUPE RIVER
A-10	PROFILES AND DETAILS - LOS GATOS CREEK
A-11	PROFILES AND DETAILS - COYOTE CREEK

REPORT OF SURVEY
ON
GUADALUPE RIVER AND ADJACENT STREAMS, CALIFORNIA
FOR
FLOOD CONTROL AND ALLIED PURPOSES

APPENDIX A

HYDROLOGY AND HYDRAULIC ANALYSES

GENERAL

A-1. SCOPE

This appendix presents basic hydrologic data and assumptions leading to an estimate of standard project flood discharge, discharge frequency, storage requirements for flood reduction by reservoirs and comments on hydraulic characteristics of existing stream systems as well as required channel dimensions for improvement leading to a high degree of protection from future flooding. Since economic justification could not be found for specific recommendations of storage or channel improvements, many details that would normally be found in a report of this nature were not developed for report presentation. Streams covered in this report are bounded by Matadero Creek on the northwest and Mission Creek on the northeast. A detailed listing of streams is presented in a later paragraph. San Francisquito Creek, adjoining Matadero Creek on the north, was included in the initial study authorization but was subsequently deleted and is being reported on under its own authorization. Major study effort was placed on Guadalupe River and Coyote Creek. Studies on adjacent streams were kept at reconnaissance detail because local sponsors have undertaken extensive improvements on these streams and indicated a desire for Federal

assistance on the two larger problem areas. The hydrology and hydraulic studies for local improvement works on adjacent streams are being accomplished by the Santa Clara County Flood Control and Water District with the degree of protection generally set at the 50-year flood on major water-courses and 10-year on storm drains.

A-2. PRIOR REPORTS

A preliminary examination on Guadalupe River and adjacent streams was prepared in 1945 and a survey report on San Francisquito Creek was forwarded to higher authority in 1961, but was returned for further studies which are currently underway.

A-3. BASIN DESCRIPTION AND CLIMATOLOGY

The area covered in this report includes about 800 square miles of the northern portion of Santa Clara County and a small part of southwestern Alameda County. The area is drained by Coyote Creek (420 square miles), Guadalupe River (160 square miles) and numerous small streams that flow into the southern end of San Francisco Bay. Plate 1 of the report is a general basin map of the area. Basin elevations range from below sea level to over 3,000 feet above sea level. The study area is bounded on the west by the Santa Cruz Mountains and on the east by the Mount Hamilton Range. Watercourse lengths range from a few miles for the smaller streams to a maximum of 75 miles for Coyote Creek. The valley and low foothill areas are becoming urbanized rapidly and there are several centers of concentrated population. The major city is San Jose through which the two largest streams flow. The climate of the area is typical of the entire San Francisco Bay area with mild winters and pleasantly warm summers. Ninety percent of the rainfall occurs in the winter

months, November through March, with about 20 percent normally occurring in January. Seasonal averages range from 14 inches at San Francisco Bay to 50 inches along the westerly basin boundary. The easterly ridge receives less rainfall due to its more remote location from the rainfall source area and moisture depletion from the air mass by the coastal barrier. Temperatures at San Jose display an average high of 81 degrees Fahrenheit during the month of July and an average low of 49 degrees during the month of January.

A-4. MAJOR STREAMS

The two streams of greatest area and runoff are Coyote Creek and Guadalupe River. These streams have numerous important tributaries and both flow through the city of San Jose. Other smaller streams draining the easterly slope of the Santa Cruz Mountains flow directly into San Francisco Bay through areas which have become densely populated during the past ten years. A tabulation of the major tributaries of Guadalupe River and Coyote Creek as well as most of the minor streams which flow directly into the Bay follows:

<u>Stream Name and Index Point</u>	<u>Drainage Area in Square Miles</u>
Matadero Creek at Palo Alto	7.2
Adobe Creek at Bayshore Highway	9.9
Permanente Creek at Bayshore Highway	17
Stevens Creek at Bayshore Highway	25
Calabazas Creek at mouth	13
Saratoga Creek at mouth	54
San Tomas Aquino Creek at mouth	19
Guadalupe River at Bayshore Highway	148
Los Gatos Creek at mouth	50
Alamitos Creek at mouth	35
Canoas Creek at mouth	23
Coyote Creek at mouth	420
Silver Creek at mouth	50
Penitencia Creek at mouth	23
Berryessa Creek at W.P.R.R.	8.6
Arroyo de los Coches at W.P.R.R.	7.6
Calera Creek at Abel Road	2.3
Scott Creek at Highway 17	1.1
Agua Fria Creek at Highway 17	1.8
Mission Creek at mouth	31

These streams display steep channel slopes in their upper mountainous reaches and flatten through the valley reach and enter into the Bay through tidal sloughs.

HYDROLOGY

A-5. RAINFALL AND STREAM GAGING STATIONS

Rainfall and streamflow records have been maintained from an early date in the Santa Clara Valley. The isohyetal map of normal annual precipitation presented on Plate A-1 is based on records from about 130 gages, many of which are currently in operation. The earliest rainfall gage is located at San Jose with a continuous record extending back to 1874. The Santa Clara County Flood Control and Water District has established several recording gages since the District's formation in 1951. Data from these gages are important in establishing design rainfall intensities for small urban drainage basins.

Although hourly rainfall records at San Jose date back to 1906, the location in the valley floor does not adequately define rainfall intensities that can be expected at locations of higher elevation and rainfall. Rainfall records at U.S. Weather Bureau stations are published in the various Climatological Data publications of that agency. A compilation of records maintained by Federal, State, local agencies and private individuals was made in 1962 for the Santa Clara County Flood Control and Water District by a private engineering firm. Records of streamflow date back to 1902 when the gage on Coyote Creek near Madrone was installed. However, runoff data on other streams were not collected until 1930 when several gages were installed in the area. The Santa Clara Valley Water Conservation District, formed in 1929, has done much to inventory both ground and surface water resources and maintains records of evaporation and percolation. The District has published a compilation of available rainfall records, low flow runoff, ground water levels, reservoir water levels and percolation data collected by them during the period 1935-61. Other data on streamflow are published in the annual "Surface Water Supply Records" by the U.S. Geological Survey.

A-6. EXISTING RESERVOIRS

There are numerous reservoirs on the streams in the study area, most of which are privately-owned small-capacity reservoirs used for irrigation, water for livestock or recreation purposes. Reservoirs for diversion and storage of water for domestic purposes were constructed by the San Jose Water Works as early as 1877. These include Lake Rancy (337 acre-feet), Lower Howell (153 acre-feet), Upper Howell

(243 acre-feet) and Williams (160 acre-feet). The latest development by that agency is Austrian Dam (6,200 acre-feet) located on Los Gatos Creek. The Santa Clara Valley Water Conservation District initiated a construction program in 1935 for surface diversion and ground water recharge. The largest reservoir in their network is Leroy Anderson Reservoir (91,300 acre-feet) completed in 1950 on Coyote Creek. None of the reservoirs has specific storage allotted for flood-control. Some reduction is effected when storms occur early in the flood season when the reservoirs normally have been evacuated by releases percolation of stored water. Data on the major reservoirs of the area are presented in the tabulation which follows:

<u>Name of Dam</u>	<u>Drainage area (sq.mi.)</u>	<u>Owner</u>	<u>Date con- structed</u>	<u>Storage capacity (ac.ft.)</u>
Austrian (Lake Elsmán)	10	San Jose Water Works	1950	6,200
Stevens	17	SCVWCD 1/	1935	3,900
Lexington	37	SCVWCD	1952	21,400
Vasona	43	SCVWCD	1935	750
Guadalupe	6	SCVWCD	1935	3,500
Almaden	12	SCVWCD	1935	2,000
Calero	7	SCVWCD	1935	9,600
Coyote	120	SCVWCD	1936	24,500
Anderson	193	SCVWCD	1950	91,300

1/ Santa Clara Valley Water Conservation District

A-7. MAJOR STORMS AND FLOODS

Flood-producing storms have occurred within the study area every few years but damage from flooding has become increasingly serious in recent years as a result of the rapid urban development. Newspaper accounts mention notable flood damage during 1862, 1893, 1911 and 1919 but very little statistical data are available. The 25,000 c.f.s.

(cubic feet per second) flood peak recorded during March 1911 was the greatest of record at the gaging station, Coyote Creek near Madrone, 1902-12, and 1916-65. However, there has been significant regulation by Coyote Dam since 1936 and by Anderson Dam since 1950. A major storm occurred 10-13 November 1950 but runoff was minor due to dry antecedent conditions and a significant amount of available storage in reservoirs. Flood-producing storms have occurred during February 1940, April 1941, January 1952, December 1955, April 1958 and January 1963. Rainfall and runoff data at selected stations during these storms are presented in Table A-1.

A-8. The flood of 2 April 1958 resulted in the greatest discharge on the Guadalupe River at San Jose since records began in 1930. The peak discharge of 9,150 c.f.s. occurred at a time when all of the upstream reservoirs were spilling. It is estimated that the flood of December 1955 would have been about 17,000 c.f.s. on the Guadalupe River at San Jose if the upstream reservoirs had not provided complete or partial control of runoff. The December 1955 flood is the greatest of record (1933-66) on Saratoga Creek with a peak discharge of 2,730 c.f.s. from a contributing area of 9.2 square miles. Farther north, Matadero Creek at Palo Alto (1953-66), also recorded its maximum discharge, 854 c.f.s. during December 1955. All evidence indicates that the December 1955 storm and flood were the greatest of record on those basins which were not significantly affected by storage reservoirs. Annual maximum discharges for Guadalupe River at San Jose, Stevens Creek near Cupertino, Saratoga Creek at Saratoga and Matadero Creek at Palo Alto are given in Tables A-2, A-3 and A-4. Typical discharge

hydrographs during major flood events are presented in Plates A-3 and A-4.

A-9. STANDARD PROJECT STORM AND FLOOD

The term "standard project storm" is used herein to denote that storm used to derive the standard project flood and represents the most severe combination of meteorological and hydrological conditions reasonably characteristic of the region, excluding, extremely rare combinations or events. The standard project flood is developed from this storm by assuming the storm is centered over the study basin with antecedent conditions reasonably favorable to runoff. The standard project flood is used as a basis of evaluating the degree of protection provided by a selected design discharge and usually establishes the upper limit of discharge values considered for channel or flood-control storage design. Notably severe storms which have proven critical in establishing the standard project storm of other streams in the San Francisco Bay area are 9-12 December 1937, 21-24 December 1955 and 11-13 October 1962. The 21-24 December 1955 storm has been adopted in this study as the standard project storm as it resulted in the largest peak discharge on Coyote Creek and Guadalupe River, although the October 1962 and December 1955 storm transpositions resulted in about equal peak discharges on the smaller basins. When storm rainfall depth is expressed as a percentage of normal annual rainfall, the major center of the December 1955 storm was found to be in the Hollister area about 40 miles southeast of San Jose. The storm was transposed by means of a depth area curve developed from the storm isopercentual lines shown on Plate A-4. Loss rates varying from

0.28- to 0.17-inch per hour at the beginning of the storm to a minimum of 0.11- to 0.06-inch per hour were applied to the rainfall, and a discharge hydrograph developed by unit hydrograph procedure. The higher rates were used for the areas draining into Guadalupe River basin reservoirs where the ground cover is conducive to higher infiltration. Inflow hydrographs were developed for each reservoir and spillway outflow hydrographs computed by reservoir routing procedures, assuming reservoirs were full at the beginning of storm runoff. Sub-basin hydrographs were then combined by channel routing, or time adjustment, to arrive at the estimated standard project flood discharge in lower reaches of the streams. Seventy-two-hour storm rainfall values range from about 22 inches for the area upstream of Austrian Dam to 7 inches for the areas near the Bay, depending on the area and normal annual precipitation. For the 580 square-mile area included in the combined Coyote Creek and Guadalupe River drainage basins, the 72-hour storm rainfall was computed at 50 percent of the normal annual precipitation and on areas less than about 20 square miles, the total storm rainfall was estimated at 52 percent of the normal annual basin precipitation. Total storm rainfall was distributed by an average of three recorders near the storm center area. Distribution "A" shown on Table A-5 was used on the basins of relatively high rainfall, Guadalupe River and tributaries and Coyote Creek upstream of Anderson Dam. Distribution "B" was used on the east side tributaries of Coyote Creek. Standard project storm and flood peak discharge values at representative index points are given in the tabulation which follows:

STANDARD PROJECT STORM-FLOOD DATA

Index Point	Drain- age Area (sq.mi.)	Normal	72-Hour Storm		Peak Discharge (c.f.s.)
		Annual Precipitation (inches)	Rainfall- Runoff (Basin Inches)		
Matadero Cr. at Palo Alto	7.2	18	-		2,200 <u>1/</u>
Baron Cr. at Bayshore Highway	3.5	19	-		1,600 <u>1/</u>
Adobe Cr. at Bayshore Highway	9.9	20	-		3,200 <u>1/</u>
Permanente Cr. at Bayshore Highway	17	22	-		4,500 <u>1/</u>
Stevens Cr. at Bayshore Highway	25	22	-		5,000 <u>1/</u>
Calabazas Cr. at Saratoga Cr.	13	20	-		3,500 <u>1/</u>
Saratoga Cr. at Saratoga	9.2	44	-		6,000 <u>1/</u>
San Tomas Aquinas Cr. at Stevens Creek Blvd.	19	19	-		4,600 <u>1/</u>
Los Gatos Cr. at Lexington Dam	37	40	20.6	13.5	13,000
Los Gatos Cr. at mouth	50	36	18.8	11.9	15,000
Guadalupe Cr. at New Guada- lupe Dam site	13	27	14.2	9.4	4,000
Alamitos Cr. at mouth	35	26	13.3	8.0	9,400
Canons Cr. at mouth	23	15	7.8	3.4	2,100
Guadalupe R. after junction Alamitos Cr.	53	26	13.5	8.0	14,000
Guadalupe R. before junction Los Gatos Cr.	96	21	10.9	7.0	19,000

^{1/} Reconnaissance quality estimates based on curves developed during San Francisco Bay and tributaries studies. No detailed hydrographs were computed.

STANDARD PROJECT STORM-FLOOD DATA (Continued)

Index Point	Drain- age Area (sq.mi.)	Normal	72-Hour Storm		Peak Discharge (c.f.s.)
		Annual Precipita- tion (inches)	Rainfall- Runoff (Basin Inches)		
Guadalupe R. at San Jose	146	26	13.8	8.7	30,000
Coyote Cr. at Coyote Dam	120	22	11.4	7.7	16,500
Coyote Cr. at Anderson Dam	193	22	11.2	7.5	23,000
Coyote Cr. at Edenvale	229	21	11.0	7.2	26,000
Coyote Cr. at E. Julian St.	238	21	10.9	7.1	26,000
Silver Cr. before junction					
Dry Cr.	7.3	14	7.4	4.2	1,000
Dry Cr. at mouth	18	16	8.4	5.3	3,100
Silver Cr. after junction					
Dry Cr.	25	16	8.1	5.0	4,100
Silver Cr. at mouth	50	16	8.2	4.9	6,500
Coyote Cr. after junction					
Silver Cr.	292	20	10.4	6.7	30,500
Penitencia Cr. at King Rd.	23	21	11.1	7.3	4,300
Coyote Cr. after junction					
Penitencia Cr.	315	20	10.5	6.8	33,200
Berryessa Cr. at W.P.R.R.	8.6	17	8.9	5.6	1,700
Arroyo de los Coches at					
W.P.R.R.	7.6	17	8.8	5.6	1,700
Calera Cr. at Abel Rd.	2.3	19	10.0	6.6	700
Scott Cr. at Highway 17	1.1	17	8.9	5.3	300
Coyote Cr. at Dixon Rd.	366	20	10.2	6.6	40,000
Coyote Cr. and Guadalupe R.	580	21	10.5	6.6	56,000

A-10. FLOOD-CONTROL STORAGE REQUIREMENTS

Several sites on Guadalupe River and Coyote Creek were investigated for flood-control storage requirements and potential reduction in discharge in the downstream problem reaches. Since the water resources of these basins are extensively developed, it is only natural that consideration be given to enlarging the existing facilities to include definite flood-control storage features. These investigations included some thought to each of the existing reservoirs of the Santa Clara Valley Water Conservation District, as well as investigation of a potential multiple-purpose development at the New Guadalupe damsite about three

miles downstream from the existing Guadalupe Dam and Reservoir. Almaden, Guadalupe and Calero Reservoirs control such a small percentage of the drainage area upstream of the major damage reach that flood-control storage at these sites would require extensive downstream channel improvements, and it proved more economical to concentrate entirely on channel works. Enlargement of the Lexington Dam and Reservoir would have more beneficial effects on the Guadalupe River downstream from Los Gatos Creek than the sum of all the other sites. Another site, designated as the Hooker damsite, located on Los Gatos Creek between Austrian Dam (Lake Elsmán) and Lexington Reservoir was considered as an alternate but would obviously accrue less benefits since the drainage area controlled would be smaller. Lake Elsmán is owned and operated by the San Jose Water Works Company as a municipal source and offers no significant incidental flood-control benefits because of carry-over storage requirements to assure a dependable water supply. The reservoirs of the Santa Clara Valley Water Conservation District are used primarily for ground water recharge by release and percolation of stored water during the low runoff season and are quite often drawn down to the point where runoff from many otherwise damaging floods can be stored in the reservoirs. This is particularly true in the case of Anderson and Coyote Reservoirs which are located in tandem on Coyote Creek and have an aggregate storage capacity of about 116,000 acre-feet, representing a runoff of 11.2 inches from the 193-square-mile contributing area. The normal annual runoff from the basin is about 5 inches. Controlling storage was available during the flood of December 1955 and was sufficient during the April 1958 event to delay spill until

downstream runoff had crested. Anderson Dam and Reservoir has spilled only twice since completion in 1950; namely, March 1952 and April 1958. Other years since 1903 when the reservoir likely would have filled are 1907, 1911, 1938 and 1941. The year of greatest runoff from the basin above Anderson Dam during the period 1903-66 is 1907, when there were 204,000 acre-feet of runoff. The storage required to completely contain all runoff during the December 1955 flood event and the standard project flood is given in the following tabulation:

RUNOFF AT POTENTIAL FLOOD CONTROL STORAGE SITES

Damsite	Drainage Area (sq. mi.)	Runoff in acre-feet during	
		21-25 Dec. 1955	Standard Project Flood
Hooker	17	8,000	13,000
Lexington	37	16,800	27,000
New Guadalupe	13	4,800	6,600
Anderson	193	35,000	78,000

Flood-control storage 30 to 40 percent less than standard project flood runoff would be adequate to obtain maximum downstream discharge reduction during the standard project flood occurrence if a spillway is provided to induce the required surcharge storage, and thereby delay spill until after runoff from the uncontrolled area recedes.

A-11. EFFECT OF FLOOD-CONTROL STORAGE

a. Hooker damsite. Eight-thousand acre-feet of flood-control storage at the Hooker damsite would result in reducing the standard project flood peak discharge on Guadalupe River at San Jose from 30,000 c.f.s. to 25,000 c.f.s. This regulated discharge would still

require channel modification to bring the channel capacity up to this design discharge.

b. Lexington Dam. By raising Lexington Dam 42 feet, modifying the spillway and relocating parts of State Highway 17, 18,000 acre-feet of flood-control storage could be provided at this site to reduce the standard project flood peak at San Jose to 18,000 c.f.s.

c. New Guadalupe damsite. Flood-control storage at the New Guadalupe site located three miles downstream from existing Guadalupe Dam could control runoff from 13 square miles. Flood-control storage at this site would result in discharge reductions and commensurate reduction in damages on the ten-mile reach of Guadalupe River between the damsite and Los Gatos Creek. Downstream from Los Gatos, effects would be minor. Three thousand acre-feet of flood-control storage at the New Guadalupe site would reduce the standard project flood peak discharge at San Jose from 30,000 c.f.s. to 27,000 c.f.s.

d. Anderson Dam. In order to accomplish maximum control of the standard project at Anderson Dam on Coyote Creek it would be necessary to provide 65,000 acre-feet of flood-control storage by raising the dam about 45 feet and modifying the spillway. This storage would be capable of reducing the standard project flood peak discharge on Coyote Creek at San Jose, after confluence with Silver Creek, from a discharge of 30,500 c.f.s. to 11,000 c.f.s. Incidental reductions in discharge and accompanying reduction in damages are presently accrued by the nature of the ungated spillways at the existing reservoirs which induce considerable spillway surcharge even if the reservoirs are full at the beginning of storm runoff. For example, the standard project flood discharge on Coyote Creek after confluence with Silver Creek

at San Jose would be 41,000 c.f.s. if no credit were given to spillway surcharge in existing reservoirs. Modifications in downstream peak discharges during the occurrence of a standard project flood have been reflected in the development procedures discussed in the paragraph "Standard Project Storm and Flood." In addition, the very nature of reservoir operation and planned use of existing storage results in happenstance flood reduction during many years. This latter condition is not dependable as there is no assurance that two or more abnormally wet seasons will not occur in sequence with insufficient time to evacuate stored water due to limited percolation rates. Also, with plans for utilizing water imported under contract with the State of California and authorized Federal projects, it is possible that Anderson Reservoir and ground water storage may be maintained at a higher level, resulting in less favorable storage capacity available for controlling future storms. Based on present operating procedures, it is estimated that Anderson Reservoir would have spilled 11 times during the past 60 years but not all of these would have contributed to the downstream maximum discharge.

A-12. DISCHARGE FREQUENCY

Discharge frequency curves were developed for the two major streams based on gaged and estimated annual maximum discharges. Estimates of peak discharges were based on the assumption that (a) reservoirs were always full at the occurrence of the annual maximum event; (b) reservoirs were nearly empty and did not spill during the maximum event; and (c) conditions as actually existed since construction of all reservoirs, and estimating their probable storage condition prior to

construction. The adopted pre-project conditions utilized in evaluating the reduction in average annual damages creditable to flood-control storage at various damsites followed condition (c) for the more frequent events and was judiciously adjusted toward condition (a) at the infrequent portion of the curves. Condition (a) was assumed to precede the standard project flood. Discharge-frequency curves for the west side streams lying to the north of Guadalupe River basin were prepared to reconnaissance quality standards for use in estimating the average annual damages from flooding in those basins. Discharge data are available for Saratoga Creek and Matadero Creek and the discharge-frequency curves on the other basins were based on drainage area relations, normal annual precipitation differences and comparison of estimated standard project flood values for the various basins. Annual maximum discharges for Matadero Creek at Palo Alto, Saratoga Creek at Saratoga, Guadalupe River at San Jose, Coyote Creek near Madrone and Penitencia Creek at San Jose are presented in Tables A-2, A-3 and A-4 for the period for which records are available and under the watershed conditions existing at the time. Discharge-frequency curves for these and other selected index points are presented in Plates A-7¹ through A-7⁵. Values taken from the adopted discharge-frequency curves and estimates at other selected index points are summarized in the tabulation which follows:

DISCHARGE FREQUENCY DATA

<u>Stream and Index Point</u>	<u>2-year</u>	<u>Exceedence Interval in Years</u>			
		<u>10-year</u>	<u>20-year</u>	<u>50-year</u>	<u>100-year</u>
		(discharge in c.f.s.)			
Matadero Cr. at Palo Alto	260	880	1,100	1,450	1,700
Adobe Cr. at Bayshore Hwy	300	1,200	1,900	2,300	3,200
Permanente Cr. at Bayshore Hwy	600	1,600	2,200	2,900	3,500
Stevens Cr. near Cupertino	200	950	1,250	1,700	2,000
Calabazas Cr. at mouth	400	1,300	1,800	2,300	2,800
Saratoga Cr. at Saratoga	420	1,500	2,100	3,300	4,400
San Tomas Aquinas Cr. at Stevens Cr. Blvd.	600	1,600	2,200	2,900	3,500
Guadalupe River at San Jose	1,000	6,600	9,300	13,500	17,000
Coyote Cr. near Madrone	200	2,500	4,500	10,000	14,000
Coyote Cr. after junction Silver Cr.	1,400	6,200	8,800	13,500	19,000

A-13. WATER RESOURCES

The water needs of the Santa Clara County area will be met by existing and planned water resource development. Surface storage by reservoirs of the Santa Clara Valley Water Conservation District totals about 157,000 acre-feet, producing an average annual yield under present methods of operation of about 60,000 acre-feet. Development of surface storage at the New Guadalupe site would make use of some of the runoff which is presently wasted to the Bay during years of excess runoff. Estimates by the Water Conservation District indicate that an average annual yield of 3,500 acre-feet could be developed from a storage capacity of 5,500 acre-feet at the New Guadalupe site. Estimates of increased yield from Lexington Reservoir on Los Gatos Creek

indicate that during a typical 20-year runoff period (1943-62) an additional average annual yield of about 1,400 acre-feet could be developed by increasing the conservation storage by 5,000 acre-feet, or an increase of 6,400 acre-feet per year could be developed by increasing storage by 38,000 acre-feet. The present average yield is about 11,000 acre-feet per year from 21,400 acre-feet of storage. Studies by others indicate that the most economical source of additional water is from the South Bay Aqueduct, a feature of the State of California Water Plan, and the proposed San Felipe project of the U.S. Bureau of Reclamation.

HYDRAULICS

A-14. HYDRAULIC DESIGN CRITERIA

Channel improvements would consist of unlined trapezoidal earth channels with and without levees in the lower reaches, riprapped lined trapezoidal sections where design velocities would cause erosion and concrete lined rectangular channels through highly developed urban and commercial areas. Design discharge velocities are subcritical in the unlined and riprap lined channels and supercritical in the concrete lined channels. The hydraulic design is in accordance with criteria presented in the preliminary draft of EM 1110-2-1601, "Hydraulic Design of Flood Control Channels." Design water surface determinations for the channels in the lower reach of Guadalupe River and Coyote Creek are based on backwatering from a mean higher high water tidal condition at the mouth of the streams coincident with peak design discharge, or highest estimated tide with 25 percent of the design discharge. Normal

depth of flow computations were used for determining the water surface profiles in the upper reaches. Adopted "n" values for use in Manning's Formula are:

- | | |
|---|-------|
| a. Trapezoidal unlined channels | 0.030 |
| b. Trapezoidal channels with riprap lined side slopes | 0.035 |
| c. Rectangular concrete lined channels | 0.014 |

Minimum freeboards provided over a design water surface and/or highest estimated tides are:

- | | |
|---|--------|
| a. Trapezoidal unlined channels | 3 feet |
| b. Trapezoidal channels with riprap lined side slopes | 3 feet |
| c. Concrete lined channels | |
| (1) Design water surface above general ground elevation | 3 feet |
| (2) Design water surface below general ground elevation | 1 feet |

A-15. PRESENT CONDITIONS - GUADALUPE RIVER

The Santa Clara County Flood Control and Water District has constructed, or assisted in construction of, a portion of their plan for channel improvements on the Guadalupe River during the period 1959 to the present. The improved channel is designed for a capacity of 12,000 c.f.s. with three feet of freeboard. The completed work extends from the Interstate Highway 280 crossing downstream 6.6 miles to the Southern Pacific Company railroad crossing in the town of Alviso. Levees extend from Brokaw Street to the downstream end of the project. The present channel provides a marked improvement over former channel capacities. Bridges within the improved reach have been enlarged

commensurate with the improved channel section and the channel has been completely realigned from the Alviso-Milpitas Road crossing to the downstream end of the work in Alviso. In general, the improved channel follows the former channel alignment upstream of the Alviso-Milpitas Road to Interstate Highway 280. The reach from Alviso extending four miles downstream to Coyote Creek Slough has been partially improved. The bottom width varies from 200 to 600 feet and the crests of the levees vary from six to ten feet in elevation throughout. A large channel section is required due to the existing and adopted flat hydraulic gradient. Levees for a distance of 1,500 feet alongside the town of Alviso, which is about five feet above mean sea level, have not been fully improved. The estimated channel capacity in this reach is between 8,000 and 10,000 c.f.s., and flows in excess of these amounts may cause inundation in the Alviso area. The existing Southern Pacific Company railroad bridge at Alviso is periodically inundated during extreme high tides. The local occurrence of land subsidence has added to the problem.

A-16. Existing channel capacities from Interstate Highway 280 to the junction of Los Gatos Creek are estimated to be 10,000 c.f.s., except directly below the junction at St. John Street where a low area on the right bank reduces the channel capacity somewhat. The channel size and capacity of the Guadalupe River upstream of Los Gatos Creek are variable. Channel conditions vary from good to fair with some poor alignments, unstable bank conditions and undesirable obstructions. Channel capacities range from 10,000 c.f.s. to a minimum of about 5,000 c.f.s. toward the upstream end of the project.

A-17. The channel capacity of Los Gatos Creek upstream of Dry Creek exceeds 7,000 c.f.s. in the wide downstream part but reduces to 3,500 c.f.s. in the narrower channel upstream of Vasona Dam; the extent of flooding during greater flows would be small and restricted in area. Downstream of Dry Creek, the channel has minimum sections with capacities as low as 4,000 c.f.s. All bridges in the reach between the confluence with the Guadalupe River and Dry Creek would require major to minor modification or transitioning of the channel sections through the bridges.

A-18. FLOOD-CONTROL SOLUTIONS CONSIDERED - GUADALUPE RIVER

The present urban character of much of the Guadalupe flood plain and the expected future urban development of the remaining area of the flood plain justify consideration of a high degree of protection; particularly, where levees are required as part of the plan of improvement. The selected plan of improvement for Guadalupe River would consist of an improved channel through the flood plain which would increase the scope of the county project to provide standard project flood protection. Completion of the first stage construction of the county project would provide a 35-year protection if upstream conservation reservoirs continue to be operated in the future as in the past.

A-19. The alternative solution to the Guadalupe River flood problem would be the modification of Lexington Dam to provide 16,000 acre-feet of assured flood-control storage between 1 November and 1 April and completion of the first stage construction of the county project on Guadalupe River. This storage would increase the degree of protection

of the county channel below Los Gatos Creek to a 1 percent chance flood and would provide the same degree of protection on Los Gatos Creek without any channel improvement. Flooding would not be prevented on the Guadalupe River above the junction with Los Gatos Creek or in parts of Alviso where a high-flood potential from adjacent Coyote Creek would remain, unless accompanied by improvements on Coyote Creek. However, it is doubtful if channel improvement on these reaches could be justified incrementally on the basis of damage prevented. Preliminary studies were also made to determine the feasibility of providing flood-control storage on Guadalupe Creek at the New Guadalupe damsite and at the existing Calero and Almaden conservation reservoirs. Due to the small drain-age areas controlled by these dams, the downstream reductions in flood peaks are too small to justify detailed studies.

A-20. PLAN OF IMPROVEMENT - GUADALUPE RIVER

The plan for improving the channel of Guadalupe River including the lower reach of Los Gatos Creek is presented on Plates A-8 to A-10. The plan would provide protection against the following standard project flood peak discharges:

<u>Location</u>	<u>Discharge</u> (c.f.s.)
<u>Guadalupe River</u>	
Downstream from the confluence of Los Gatos Creek	30,000
Upstream from the confluence of Los Gatos Creek to Canoas Creek	16,000
From Canoas Creek to Branham Lane	14,000
<u>Los Gatos Creek</u>	
Mouth to confluence of Dry Creek	14,000

The lower end of the plan of improvement in Alviso Slough would consist of a 19,000-foot reach of trapezoidal channel with bottom width of 400 feet and 1 on 5 sides slopes with levee grade established to provide a minimum of three feet of freeboard. Design flow depths would vary from 27 feet to 17 feet in the reach from the mouth of Alviso Slough to the town of Alviso.. In the 1,700-foot reach below the Southern Pacific Company railroad crossing at Alviso, the channel would transition to a bottom width of 200 feet. The bottom width would transition to 180 feet in 2,400 feet and to 170 feet in 1,600 feet in the reaches upstream extending to the Alviso-Milpitas Road. In the 21,000-foot reach extending from the Alviso-Milpitas Road to the Bayshore Freeway crossing, the side slopes would be 1 on 3 and the bottom width would transition to 90 feet with flow depths varying from 17 to 23 feet. A two-foot drop structure would be located 900 feet downstream of the Montague Road crossing. The trapezoidal leveed channel in the 10,200-foot reach between Bayshore Freeway crossing and the Interstate Highway 280 crossing would have a 90-foot bottom width with flow depths varying from 24 to 25 feet. Side slopes would vary from 1 on 3 to 1 on 2.5. There would be four 6-foot drops in the reach. A transition and stilling basin structure at the upstream end of the earth channel would join the downstream end of the rectangular concrete lined channel about 1,200 feet upstream of Interstate Highway 280.

A-21. Proceeding upstream, the 7,100-foot reach to a proposed transition structure at St. John Street would consist of a 100-foot wide rectangular concrete lined channel. Channel flow depth would be 11.5 feet. A junction transition structure would extend from St. John Street through the confluence of Los Gatos Creek and the Guadalupe River. The rectangular concrete lined channel in the 10,900-foot reach from St. John Street to West Alma Avenue would have widths varying from 85 feet at the downstream end to 65 feet at the upstream end with depths of flow varying from 12 to 10 feet. A trapezoidal earth channel with riprapped sides would extend 18,700 feet to the upstream end of the project at Branham Lane. The bottom width would vary from 40 to 35 feet and the flow depths from 15 to 17 feet.

A-22. The proposed channel alignment and grades were selected to follow as closely as practical the existing channel. Drop structures would be required in the reach starting from a point immediately below Montague Road bridge and extending upstream to the proposed concrete lined section near the Guadalupe Parkway bridge. The flat gradient of the streambed between the drop structures keeps the design velocities below 8 feet per second and eliminates the need for riprap lining of the channel. In the tidal area the unlined section would have design velocities of about 2 feet per second, increasing to 8 feet per second at the upstream end near the Montague Road bridge. The design velocity in the concrete lined channel reach would be 26 feet per second. The trapezoidal section upstream from West Alma Avenue would require riprap on the side slopes to prevent erosion. The design

velocities would be 10 to 12 feet per second. Freeboard for the rectangular and trapezoidal channel sections would be 1 and 3 feet, respectively. Several bridges would require replacement or modification.

A-23. ~~The plan of improvement on Los Gatos Creek would consist of a rectangular concrete lined channel in the 5,000-foot reach between the confluence with Guadalupe River and Auzerais Street. The section would have a 47-foot bottom width with a water depth of 15 feet. The upstream 6,800-foot reach would consist of an earth trapezoidal section with riprap sides extending to the mouth of Dry Creek. Channel bottom width would be 40 feet with 1 on 2.5 side slopes. Velocity in the concrete section would be 21 feet per second and in the riprap section it would be 13 feet per second. Freeboard would be one foot in the rectangular section and three feet in the trapezoidal section. Several bridges would be modified to accommodate the design flow. The selected plan of improvement is shown on Plate A-8, profile and details of Guadalupe River on Plate A-9 and profiles and details of Los Gatos Creek on Plate A-10. Hydraulic design data are given in Table A-6.~~

A-24. PRESENT CONDITIONS - COYOTE CREEK:

Channel capacities on Coyote Creek are inadequate to carry infrequent floods of large magnitude. The channel has restricted sections, inadequate bridge openings, heavy growth of brush, accumulated debris and silt deposits. In the lower reach, the backwater effect during high tides further reduces the channel capacity. The estimated existing capacities vary from about 4,000 c.f.s. near the Nimitz Freeway to about 1,500 c.f.s. just upstream from Dixon Road near the Milpitas city limit.

A-25. FLOOD-CONTROL SOLUTIONS CONSIDERED - COYOTE CREEK

Preliminary studies indicate that it would not be practical to construct a dam on Las Animas Creek above Anderson Dam, or to increase the storage at the existing Anderson and Coyote Reservoirs for flood control due to the high degree of incidental flood control presently provided. The present urban character of much of the potential flood plain and predicted urban development of most of the remaining flood plain dictates that a high degree of protection should be provided, particularly in leveed areas. Preliminary design plans for channel improvement to provide standard project flood and 50-year flood protection were prepared. The plan would consist of trapezoidal earth channels with levees from the downstream end to the confluence of Miguelita Creek with Coyote Creek and continue upstream with rectangular concrete lined channels to Story Road. No improvement on tributary streams is considered due to the plans of the Santa Clara County Flood Control and Water District to improve most of the tributaries for protection against the estimated 50-year flood.

A-26. PLAN OF IMPROVEMENT - COYOTE CREEK

Present and continuing development of the flood plain for urban and commercial uses and the requirement for levees indicate that the standard project flood should be selected as the basis for the plan of improvement. The plan is presented on Plates A-8 and A-11. The design discharges were taken to vary from 26,600 c.f.s. near Story Road to about 40,000 c.f.s. at the upstream end of the tidal slough, where the capacity is sufficient to carry the design discharge. Improved channel dimensions in the 11,700-foot reach between the downstream end of the plan to Station 117+00 would consist of a bottom width of 350 feet with 1 on 5 side slopes and a levee grade at approximate elevation +10.00 feet mean sea level. In the 8,300-foot reach between Station 117+00 and Station 200+00, the channel would have a bottom width of 300 feet with 1 on 4 side slopes and varying depths of flow of 14.5 to 17.0 feet. The bottom width of the trapezoidal channel section in the reach from Station 200+00 to the confluence with Miguelita Creek would vary from 160 feet to 140 feet with 1 on 3 side slopes and would have depths of 15 to 18 feet. The levees would have an average height of 6 feet above ground for a distance of 2.7 miles upstream from Station 117+00 to the Alviso-Milpitas Road. Freeboard would be 3 feet minimum. The 13,500-foot reach of rectangular concrete lined channel from the confluence with Miguelita Creek to Story Road would have bottom widths varying from 70 to 50 feet with wall heights of 25 to 26 feet. One foot minimum freeboard would be provided in the concrete section. It is estimated that some ten bridges would need to be

replaced. The selected plan of improvement is shown on Plate A-8 and profiles and details are shown on Plate A-11. Hydraulic design data are given in Table A-6.

A-27. OTHER STREAMS

Other streams in the area covered by the authorization include Matadero Creek, Adobe Creek, Permanente Creek, Stevens Creek, Calabazas Creek, Saratoga Creek and San Tomas Aquinas Creek. A field investigation was conducted to determine the need for possible flood-control improvement on these streams. The Santa Clara County Flood Control and Water District has done work on most of these streams and plans work on the remainder to provide protection up through the estimated 50-year flood. Residual flood damages are too small to warrant enlarging the county improvements to provide for a higher degree of flood protection.

A-28. INTERIOR DRAINAGE

No detailed plans for interior drainage have been developed. Connections would be made to existing lines draining into the channels, and additional drainage facilities and ponding areas would be provided where construction would interrupt the present drainage pattern.

TABLE A-1

Hydrologic Data
Major Storms Since 1940

Storm Dates	Rainfall at Selected Stations			Basin Runoff and Peak Discharge			
	San Jose (Inches)	Wrights (Inches)	Coyote Dam (Inches)	Coyote Creek ^{1/} nr Madrone (196 sq.mi.)	Guadalupe River at San Jose ^{1/} (146 sq.mi.)	Saratoga Creek at Saratoga (9.2 sq.mi.)	Matadero Creek nr Palo Alto (7.2 sq.mi.)
26-29 February 1940	2.61	11.55	4.35	2.3 in. 3,920 cfs	4.3 in. 8,680 cfs	7.0 in. 2,540 cfs	4.6 in. ^{2/} 600 cfs ^{2/}
3-6 April 1941	1.36	4.68	2.08	1.5 in. 4,180 cfs	1.9 in. 6,330 cfs	3.1 in. 608 cfs	1.7 in. ^{2/} 550 cfs ^{2/}
16-19 November 1950	2.56	14.37	3.46	1.1 in. 230 cfs	1.1 in. 2,730 cfs	2.5 in. 826 cfs	N.R.
10-13 January 1952	2.75	7.62	3.33	2.8 in. 65 cfs	3.9 in. 8,000 cfs	4.3 in. 1,430 cfs	N.R.
21-24 December 1955	3.55	16.64	7.87	3.1 in. 10 cfs	4.7 in. 5,570 cfs	6.0 in. 2,730 cfs	2.9 in. 854 cfs
1-4 April 1958	2.82	9.38	5.16	2.1 in. 5,750 cfs	4.1 in. 9,150 cfs	4.9 in. 772 cfs	2.7 in. 672 cfs
29 January - 1 February 1963	6.46	19.61	10.03	2.3 in. 10 cfs	5.6 in. 6,240 cfs	5.9 in. 1,160 cfs	1.5 in. 641 cfs

^{1/} Basin runoff in inches is adjusted to include change in storage of reservoirs. Peak discharge is that which was recorded under conditions at the time of storm occurrence.

^{2/} Estimated as equal to Los Trancos Creek at Stanford University.

N.R. - No record.

TABLE A-2

Annual Maxima Discharges
Typical of Unregulated Streams

Matadero Creek at Palo Alto (7.2 sq. mi.)		Saratoga Creek at Saratoga (9.2 sq. mi.)		Penitencia Creek at San Jose 1/ (21.5 sq. mi.)	
Date	Discharge (c.f.s.)	Date	Discharge (c.f.s.)	Date	Discharge (c.f.s.)
		1 Jan. 1934	314		
		4 Jan. 1935	254		
		21 Feb. 1936	268		
		13 Feb. 1937	910		
		2 Feb. 1938	611		
		8 Mar. 1939	110	6 Feb. 1939	44
		27 Feb. 1940	2,540	31 Mar. 1940	257
		4 Apr. 1941	608	4 Apr. 1941	184
		24 Jan. 1942	620	6 Feb. 1942	240
		21 Jan. 1943	1,650	9 Mar. 1943	123
		4 Mar. 1944	175	4 Mar. 1944	163
		1 Feb. 1945	898	26 Mar. 1945	93
		21 Dec. 1945	287	4 Jan. 1946	73
		22 Nov. 1946	100	10 Mar. 1947	10
		29 Apr. 1948	134	24 Mar. 1948	26
		11 Mar. 1949	293	12 Mar. 1949	79
		5 Feb. 1950	222	17 Jan. 1950	69
		18 Nov. 1950	826	5 Jan. 1951	220
		12 Jan. 1952	1,240	15 Jan. 1952	372
		7 Dec. 1952	494	30 Dec. 1952	35
		17 Jan. 1954	232	14 Feb. 1954	19
		26 Feb. 1955	107	19 Jan. 1955	60
		22 Dec. 1955	2,730	23 Dec. 1955	872
		24 Feb. 1957	225	6 Mar. 1957	23
		2 Apr. 1958	772	3 Apr. 1958	509
		16 Feb. 1959	683	21 Feb. 1959	70
		8 Feb. 1960	178	10 Feb. 1960	71
		1 Dec. 1961	129	29 Jan. 1961	12
		14 Feb. 1962	432	16 Feb. 1962	94
		31 Jan. 1963	1,250	28 Mar. 1963	123
		20 Jan. 1964	338	21 Jan. 1964	57
		5 Jan. 1965	535	23 Dec. 1964	308
6 Dec. 1952	535				
19 Mar. 1954	26				
18 Jan. 1955	170				
22 Dec. 1955	854				
24 Feb. 1957	28				
2 Apr. 1958	672				
16 Feb. 1959	340				
8 Feb. 1960	139				
25 Nov. 1961	45				
5 Mar. 1962	365				
31 Jan. 1963	600				
20 Jan. 1964	223				
5 Jan. 1965	219				

1/ Mean daily values; peak discharges available after 1961.

TABLE A-3

Annual Maxima Discharges - Guadalupe River at San Jose
(Drainage Area 146 square miles).

WYR	Date	Discharge in Cubic Feet per Second		
		Recorded Discharge	Adjusted to 1952-65 Reservoir Condition and Operation	Adjusted to Condition of full Reservoirs at Beginning of Annual Maximum Event
1930	5 Mar. 1930	4,330	1,700	3,700 -
31	Oct. '30-Sep. 1931	0	100	100 -
32	27 Dec. 1931	6,700	2,700	5,000 -
33	29 Jan. 1933	365	100	300 -
34	1 Jan. 1934	2,450	1,000	2,100 -
35	9 Jan. 1935	1,650	700	1,400 -
36	21 Feb. 1936	910	100	700 -
37	13 Feb. 1937	6,070	1,100	5,000 -
38	11 Dec. 1937	6,660	4,500	4,500 -
39	9 Mar. 1939	338	100	200 -
40	27 Feb. 1940	8,680	5,100	7,300 -
41	4 Apr. 1941	6,330	5,500	5,500 -
42	24 Jan. 1942	4,090	1,700	3,600 -
43	23 Jan. 1943	6,350	4,400	7,000 -
44	4 Mar. 1944	1,960	800	1,700 -
45	2 Feb. 1945	6,660	3,400	7,300 -
46	22 Dec. 1945	1,640	100	1,200 -
47	22 Nov. 1946	394	100	300 -
48	29 Apr. 1948	890	100	600 -
49	10 Mar. 1949	2,500	1,900	3,000 -
50	6 Feb. 1950	1,340	100	900 -
51	18 Nov. 1950	2,730	500	2,000 -
52	12 Jan. 1952	8,000	2,800	11,600 -
53	7 Dec. 1952	738	Same	1,800 -
54	13 Feb. 1954	485	as	1,200 -
55	18 Jan. 1955	608	recorded	1,500 -
56	23 Dec. 1955	5,570	discharge	17,000 -
57	24 Feb. 1957	666	"	1,700 -
58	2 Apr. 1958	9,150	"	9,150 -
59	16 Feb. 1959	1,590	"	4,000 -
60	1 Feb. 1960	125	"	300 -
61	1 Dec. 1960	279	"	300 -
62	15 Feb. 1962	1,380	"	3,500 -
63	13 Oct. 1962	6,300	"	13,500 -
64	20 Jan. 1964	1,980	"	4,300 -
65	5 Jan. 1965	1,340	"	3,000 -

Note: Almaden, Calero, Vasona and Guadalupe reservoirs with a total storage of 15,800 acre-feet were constructed in 1935; Austrian Dam (6,200 acre-feet) constructed in 1950; and Lexington Dam (21,400 acre-feet) was constructed in 1953.

36485

TABLE A -4

Annual Maxima Discharges
Coyote Creek Near Madrone
(Drainage Area 193 to 196 square miles)

Date	Recorded Discharge (c.f.s.)	Date	Recorded Discharge (c.f.s.)
19 Mar. 1905	3,000	4 Mar. 1944	3,050
19 Jan. 1906	8,350	2 Feb. 1945	6,580
11 Dec. 1906	8,210	5 Jan. 1946	504
25 Jan. 1908	2,150	23 Nov. 1946	196
21 Jan. 1909	8,230	12 Apr. 1948	221
9 Dec. 1909	3,000	11 Mar. 1949	663
7 Mar. 1911	25,000	28 Jan. 1950	365
12 Mar. 1912	1,210	22 Nov. 1950	230
21 Feb. 1917	10,100	1 Apr. 1952	93
12 Mar. 1918	2,090	7 Dec. 1952	93
10 Feb. 1919	8,030	Sep. 1954	460
22 Mar. 1920	970	17 Apr. 1955	113
30 Jan. 1921	5,130	16 May 1956	98
10 Feb. 1922	9,760	14 July 1957	127
24 Jan. 1923	9,200	3 Apr. 1958	5,750
27 Jan. 1924	8	5 Apr 1959	176
23 Feb. 1925	1,000	20 Oct. 1959	170
13 Feb. 1926	7,180	13 Apr. 1961	180
16 Feb. 1927	6,340	22 Feb. 1962	183
27 Mar. 1928	3,580	17 Jul. 1963	245
3 Feb. 1929	920	25 Mar. 1964	217
5 Mar. 1930	6,500	19 Jun. 1965	113
15 Feb. 1931	178		
28 Dec. 1931	10,600		
29 Jan. 1933	2,080		
1 Jan. 1934	2,010		
8 Apr. 1935	5,340		
22 Feb. 1936	1,020		
22 Mar. 1937	4,060		
11 Feb. 1938	6,670		
9 Mar. 1939	283		
29 Feb. 1940	3,920		
4 Apr. 1941	4,180		
6 Feb. 1942	2,230		
21 Jan. 1943	5,450		

Note: Regulation by Coyote Reservoir beginning in 1936 (capacity 24,500 acre-feet) and Anderson Reservoir beginning in 1950 (91,300 acre-feet).

TABLE A-5

Standard Project Storm Rainfall Distribution

Hourly Rainfall in Percent of 72-Hour Total				Hourly Rainfall in Percent of 72-Hour Total			
Time		Distribution	Distribution	Time		Distribution	Distribution
Hour	Day	A	B	Hour	Day	A	B
9	1	.3		1	3	5.3	6.7
10	1	.2		2	3	2.4	3.0
11	1	.4		3	3	2.0	1.9
12	1	.2		4	3	2.8	2.6
13	1			5	3	3.3	3.6
14	1	.1		6	3	2.5	3.0
15	1	.1		7	3	2.6	2.8
16	1	.2		8	3	1.8	2.2
17	1			9	3	2.0	2.1
18	1			10	3	1.8	1.7
19	1			11	3	1.0	1.0
20	1			12	3	1.3	.9
21	1	.1		13	3	1.4	1.0
22	1	.1		14	3	1.2	.9
23	1	.2		15	3	2.9	3.5
24	1	.2		16	3	2.3	4.1
1	2	.9	.1	17	3	1.2	1.8
2	2	1.3	.3	18	3	1.1	1.4
3	2	2.9	1.8	19	3	.7	1.1
4	2	4.6	4.4	20	3	1.2	1.4
5	2	1.9	3.5	21	3	.6	1.0
6	2	2.8	2.7	22	3	.6	.7
7	2	2.1	2.0	23	3	.7	.8
8	2	2.2	2.7	24	3	.7	.7
9	2	.8	1.0	1	4	.8	.8
10	2	1.0	.9	2	4	1.0	1.1
11	2	.6	.5	3	4	1.1	1.4
12	2	.4	.4	4	4	.8	1.0
13	2	.8	.6	5	4	.7	1.1
14	2	.4	.3	6	4	.5	.7
15	2	.2	.3	7	4		.4
16	2	.3	.1	8	4		.4
17	2	.3					
18	2	1.2	.2				
19	2	1.1	.2				
20	2	2.5	.7				
21	2	4.6	2.2				
22	2	4.1	4.0				
23	2	5.6	5.9				
24	2	7.0	8.4				

Notes: First day corresponds with 21 December 1955.

Distribution A is average of Freedom GWNW, Stayton Mine and Hollister recorders.

Distribution B is average of Stayton Mine, Hollister and San Juan Bautista recorders.

TABLE A-6

HYDRAULIC DESIGN DATAGuadalupe River and Adjacent Streams
Santa Clara County, California

Stream and Reach	Reach Length (Lineal feet)	Standard Project Flood Discharge (c.f.s.)	Channel Bottom Width (Feet)	Channel Bottom Slope	Depth of Water (Feet)	Average Velocity (f.p.s.)	Channel	
							Type	Side Slope
<u>GUADALUPE RIVER</u>								
Coyote Creek to Alviso-Milpitas Road	24,700	30,000	400 to 170	0.0005	25 to 17	2 to 7	Earth	1 on 5
Alviso-Milpitas Road to Montague Road	12,100	30,000	170 to 130	0.0006	17 to 21	7 to 8	Earth	1 on 5 thru 1 on 3
Montague Road to Bayshore Freeway	8,900	30,000	130 to 90	0.0007	21 to 23	8	Earth	1 on 3
Bayshore Freeway to Hamline Street	10,300	30,000	90	0.0006	23 to 25	8	Earth	1 on 3 thru 1 on 2.5
Hamline Street to Los Gatos Creek	8,500	30,000	100	0.003	11	26	Concrete	Vertical
Los Gatos Creek to West Alma Avenue	10,600	16,000	85 to 65	0.0025 0.0028	10	26	Concrete	Vertical
West Alma Avenue to Canoas Creek	8,200	16,000	65 to 40	0.0028 0.0032	15 to 17	11 to 12	Earth and Riprap	1 on 2.5
Canoas Creek to Branham Lane	10,500	14,000	40 to 35	0.0025 0.0034	17 to 16	10 to 12	Earth and Riprap	1 on 2.5

TABLE A-6 (continued)
HYDRAULIC DESIGN DATA

Stream and Reach	Reach Length (lineal feet)	Standard Project Flood Discharge (c.f.s.)	Channel Bottom Width (Feet)	Channel Bottom Slope	Depth of Water (Feet)	Average Velocity (f.p.s.)	Channel	
							Type	Side Slope
<u>LOS GATOS CREEK</u>								
Junction Guadalupe River to Anzerais Street	5,000	14,000	47	0.0020	14.5 to 15.5	21	Concrete	Vertical
Anzerais Street to Mouth of Dry Creek	7,000	14,000	35	0.0040	14	12.5	Earth	1 on 2.5
<u>COYOTE CREEK</u>								
Coyote Creek Slough to Lower Penitencia Creek	14,000	40,000	350	0.0005	15	6.3	Earth	1 on 5
Lower Penitencia Creek to Station 200+00	6,000	33,000	300	0.0005	15	6.3	Earth	1 on 4
Station 200+00 to Alviso-Milpitas Road	5,700	33,000	160	0.0011	17	9.1	Earth	1 on 3
Alviso-Milpitas Road to Fox Lane	17,700	33,000	160	0.0011	17	9.1	Earth	1 on 3
Fox Lane to Upper Penitencia Creek	10,700	33,000	140	0.0024	17 to 14	12.3	Earth	1 on 3
Upper Penitencia Creek to Miguelita Creek	4,900	30,500	140	0.0009	18 to 19	8.5	Earth	1 on 3
Miguelita Creek to Reed Street, Extended	8,300	26,600	70	0.0009	21.5	17.6	Concrete	Vertical
Reed Street, Extended to Story Road	5,200	26,600	50	0.0017	23.5	22.8	Concrete	Vertical

ON
GUADALUPE RIVER AND ADJACENT STREAMS
FOR
FLOOD CONTROL AND ALLIED PURPOSES
SANTA CLARA AND ALAMEDA COUNTIES
CALIFORNIA

APPENDIX B

FLOOD DAMAGES AND FLOOD CONTROL BENEFITS

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	INTRODUCTION	B-1
B-1	PURPOSE	B-1
B-2	LOCATION AND DESCRIPTION OF INVESTIGATION AREA	B-1
	ECONOMIC DEVELOPMENT	B-2
B-3	POPULATION	B-2
B-4	ECONOMIC CHARACTERISTICS	B-3
	FLOOD DAMAGES	B-3
B-5	AREA SUBJECT TO INUNDATION	B-3
B-6	FLOOD DAMAGE, GENERAL	B-5
B-7	HISTORICAL FLOOD DAMAGE	B-6
B-8	STANDARD PROJECT FLOOD DAMAGES	B-6
B-9	FLOOD DAMAGE ANALYSIS	B-6
	a. Discharge-frequency relationship	B-6
	b. Discharge-damage relationship	B-7
	c. Damage-frequency relationship	B-7
	d. Common flood plain	B-7
	e. County improvements	B-8
	f. Damages under existing conditions	B-8
	g. Development factors	B-9
	h. Damages under future conditions	B-9
	FLOOD BENEFIT ANALYSIS	B-10

TABLE OF CONTENTS
(Continued)

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
B-10	PROCEDURE FOR BENEFIT ANALYSIS	B-10
B-11	FLOOD CONTROL BENEFITS	B-10
	a. Guadalupe River only	B-10
	b. Coyote Creek only	B-11
	c. Combined projects, Guadalupe River and Coyote Creek	B-12
	d. Adjacent streams	B-14
B-12	LAND ENHANCEMENT	B-15
B-13	FLOOD PLAIN MANAGEMENT	B-15
B-14	SUMMARY OF FLOOD CONTROL BENEFITS	B-15

<u>Number</u>	<u>Title</u>	<u>Page</u>
B-1	POPULATION PROJECTIONS - 1960-2065	B-19
B-2	HISTORICAL DAMAGES	B-20
B-3	STANDARD PROJECT FLOOD DAMAGES	B-23
B-4	AVERAGE ANNUAL DAMAGES BEFORE AND AFTER COUNTY PROJECT	B-24
B-5	AVERAGE ANNUAL DAMAGES	B-26
B-6	DEVELOPMENT FACTORS	B-28
B-7	FUTURE AVERAGE ANNUAL DAMAGES	B-29
B-8	PROJECT BENEFITS, GUADALUPE RIVER CHANNEL WORKS ONE PERCENT FLOOD PROTECTION	B-31
B-9	PROJECT BENEFITS, GUADALUPE RIVER CHANNEL WORKS STANDARD PROJECT FLOOD PROTECTION	B-32
B-10	PROJECT BENEFITS, LEXINGTON RESERVOIR, GUADALUPE RIVER 18,000 ACRE-FEET OF FLOOD CONTROL STORAGE	B-33

TABLE OF CONTENTS
(Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
B-11	PROJECT BENEFITS, COYOTE CREEK CHANNEL WORKS TWO PERCENT FLOOD PROTECTION	B-34
B-12	PROJECT BENEFITS, COYOTE CREEK CHANNEL WORKS ONE PERCENT FLOOD PROTECTION	B-35
B-13	PROJECT BENEFITS COYOTE CREEK CHANNEL WORKS STANDARD PROJECT FLOOD PROTECTION	B-36
B-14	PROJECT BENEFITS, GUADALUPE RIVER AND COYOTE CREEK - PROJECTS IN COMBINATION	B-37
B-15	PROJECT BENEFITS, ADJACENT STREAMS CHANNEL WORKS - TWO PERCENT FLOOD PROTECTION	B-38
B-16	PROJECT BENEFITS, ADJACENT STREAMS CHANNEL WORKS - ONE PERCENT FLOOD PROTECTION	B-39
B-17	PROJECT BENEFITS, ADJACENT STREAMS CHANNEL WORKS STANDARD PROJECT FLOOD PROTECTION	B-40

PLATES

<u>Number</u>	<u>Title</u>
B-1	FLOOD PLAINS, GUADALUPE RIVER
B-2	FLOOD PLAIN, COYOTE CREEK
B-2a	FLOOD PLAIN, COYOTE CREEK
B-3	DISCHARGE - DAMAGE RELATIONSHIP

REPORT OF SURVEY
ON
GUADALUPE RIVER AND ADJACENT STREAMS
FOR
FLOOD CONTROL AND ALLIED PURPOSES

SANTA CLARA AND ALAMEDA COUNTIES
CALIFORNIA

APPENDIX B

FLOOD DAMAGES AND FLOOD CONTROL BENEFITS

INTRODUCTION

B-1. PURPOSE

This appendix summarizes the flood-control benefit studies made for Survey Report, Guadalupe River and Adjacent Streams.

B-2. LOCATION AND DESCRIPTION OF INVESTIGATION AREA

The study area comprises the greater part of Santa Clara County embracing the drainage basins of the Guadalupe River, Coyote Creek and eight major adjacent streams - Matadero, Saratoga, Permanente, Calabazas, San Tomas Aquinas, Adobe, Barron and Stevens (Plate 1). Guadalupe River rises in the Santa Cruz Mountains and flows in a northward course, emptying into San Francisco Bay at the town of Alviso. Coyote Creek rises in the Mount Hamilton Range east of Gilroy, flows northwestward through the middle of Santa Clara County and empties into San Francisco Bay east of the town of Alviso. All of the eight adjacent streams rise in the Santa Cruz Mountains and flow northeastward through heavily populated areas. Matadero, Barron, Adobe, Permanente and Stevens Creeks flow directly into San Francisco Bay, sharing a common flood plain in their lower reaches. Calabazas and Saratoga Creeks flow into San Tomas Aquinas Creek and thence into Guadalupe Slough. The flood plain of all these streams occur, for the most part, in the recently developed areas between El Camino Real and San Francisco Bay.

ECONOMIC DEVELOPMENT

B-3. POPULATION

The 1967 population of Santa Clara County is estimated at 967,000, an increase of approximately 50 percent since 1960. Major residential development and population increase have taken place in the project area. In the lower reaches of both the Guadalupe and Coyote basins, industrial and commercial expansion have taken place at a very rapid rate during the past ten years. Development of residential lands has taken place in the upper reaches of both of these basins with an accompanying decline in agricultural activity. Future development of the upper areas of the Guadalupe and Coyote basins is expected to be at a somewhat slower rate than that of the lower reaches due to the rough, mountainous character of the remaining available lands. The distance from centers of employment in the lower reaches of these basins and adjacent areas will, also, contribute to a slow growth rate. Population projections for the three basins and for Santa Clara County for the period 1960-2065 are given in Table B-1. Currently the population of the study area accounts for over 85 percent of the county total. As other areas of the county develop this percent is expected to decline to 80 percent in 2015 and 75 percent in 2065.

B-4. ECONOMIC CHARACTERISTICS

Economic activity is centered in the Guadalupe River and adjacent streams portions of the study area. Much of the present level of development has been achieved since 1955. During this period economic activity in these two basins has shifted from highly productive agriculture to a specialized manufacturing center of national importance. Much of this growth has been the result of very rapid development of the area as a major research and manufacturing center for "space-age hardware" and as a center of applied scientific research. In view of the extremely rapid rate of growth during the past ten years, the rate of economic development is expected to level off somewhat during the study period. Further shifts in land use from agricultural and residential to industrial and heavy commercial are expected to occur in the Guadalupe basin and to some extent in the Coyote basin, particularly during the latter part of the study period. It is expected that agriculture will almost completely disappear in both the Guadalupe and adjacent streams basins well within the study period and to a great extent in the Coyote basin.

FLOOD DAMAGES

B-5. AREA SUBJECT TO INUNDATION

Damage in the upper reaches of all streams in the basin has been confined mostly to bank erosion. However, sheet flooding in the lower reaches occurs in an urban residential, commercial and industrial area. More intensive urban land use and increased population density is expected to occur in these lower reaches. The flood plains of the

Guadalupe River and Coyote Creek are shown on Plates B-1, B-2 and B-2A. In reaches II and III there is a common flood plain for Coyote Creek and Guadalupe River. The area between the streams could be flooded from the right bank of Guadalupe River or the left bank of Coyote Creek. In 1958 flood waters from both Guadalupe River and Coyote Creek inundated about 1,200 acres of a common flood plain in Reach II. Guadalupe River flooded first. Before Guadalupe flood waters receded, Coyote Creek flooded. Field personnel attempted to allocate damages by determining which stream caused the primary damage to any given piece of property. Hence, flood plain damages for the left bank of Coyote Creek probably understate the damage which would be caused by a flood of the magnitude of the 1958 flood were such flood to occur independently of any flooding on Guadalupe River. There was no flooding of the common flood plain during the floods of 1955 and 1963. For purposes of analysis of damages, reaches have been delineated in the Guadalupe River and Coyote Creek subbasins as follows:

<u>Reach</u>	<u>Guadalupe River</u>	<u>Coyote Creek</u>
I	San Francisco Bay to Alviso	Mouth to Fremont-Milpitas city limits
II	Alviso to Montague Road	Alviso to Montague Road extended
III	Montague Road to Brokaw Road	Montague Road to Brokaw Road
IV	Brokaw Road to Hamline Road	Brokaw Road to Berryessa Road
V	Hamline Road to the Alameda	Berryessa Road to the Alameda
VI	The Alameda to Branham Lane	The Alameda to Story Road
VII	The Alameda to Dry Creek	

Acreage and present market value to land and improvements within the standard project flood plains of these streams follow:

Reach	Guadalupe River		Coyote Creek		Mkt Value/acre
	Acreage	Estimated Market Value (\$1,000)	Acreage	Estimated Market Value (\$1,000)	
I 1/	-	-	1,190	\$ 1,200	\$ 1008
II 2/	3,835	41,100	4,410	60,500	\$ 13,718
III 3/	2,115	59,500	1,875	72,500	38,666
IV	1,415	116,000	705	33,500	47,517
V	1,850	335,000	470	35,000	74,468
VI	<u>1,440</u>	<u>90,000</u>	<u>545</u>	<u>47,000</u>	<u>86,238</u>
Total	10,655	\$641,600	9,195	\$249,700	Ave \$ 27,156/acre

- 1/ Consists of unused marshland.
- 2/ Overlapping of flood plains in Reach II consists 2,953 acres with an estimated market value of \$31,600,000.
- 3/ Overlapping of flood plains in Reach III consists of 680 acres with an estimated market value of \$19,100,000.

B-6. FLOOD DAMAGE, GENERAL

Floods result from high intensity rainstorms, inadequate channel capacity and inadequate drainage. At higher elevations bank erosion is caused by high velocity of streamflow. Sheet flooding occurs in the lower reaches, depositing silt and debris, and causing extensive damage. During the flood of 1958, the maximum of record, the town of Alviso was inundated 17 days. Some of this inundation was caused by tidal action. Average depth of flooding has ranged from a few inches to five feet during floods of record.

B-7. HISTORICAL FLOOD DAMAGE

Complete data of damages are available only for the floods of December 1955 - January 1956, April 1958 and January 1963. The Discharge-Damage Relationship curves illustrated in Plate B-3 reflect September 1964 prices and conditions. Damages sustained in the floods of record were brought to September 1964 price levels and are shown in Table B-2. The floods of 1958 were the most damaging along both Guadalupe River and Coyote Creek, causing total damages of nearly \$2,000,000. The floods of 1955 were the most damaging along all adjacent streams causing damages of \$2,600,000 within their flood plains.

B-8. STANDARD PROJECT FLOOD DAMAGES

The discharge and damages caused by the standard project flood would far exceed those of the largest flood of record, the 1958 flood. Total damages for Guadalupe River would exceed \$16,000,000 while those for Coyote Creek would approach \$5,000,000 as indicated in Table B-3.

B-9. FLOOD DAMAGE ANALYSIS

Average annual damages were derived by the following method:

a. Discharge-frequency relationship. A frequency curve was developed for each basin from existing records, historical reports, comparison of areas and runoff characteristics and correlation of recorded discharges. Details are presented in Appendix A, "Hydrology and Hydraulic Analyses."

X

b. Discharge-damage relationship. A discharge-damage curve was prepared for each basin by plotting past damages, adjusted to present economic conditions and prices. Adjusted historical damages were supplemented by estimates of damages that would be caused by floods of sizes other than those for which records are available. This procedure was used to extend the curves to include such floods as the standard project flood.

c. Damage-frequency relationship. A curve showing damage-frequency relationships was prepared for each basin by plotting the amount of damage against the frequency of the flood that would cause such damage. These data were obtained by correlation of the discharge-frequency and discharge-damage curves. The area under the damage-frequency curves converted to its equivalent value in dollars represents the average annual damage.

d. Common flooded plain. In Reaches II and III there is a common flood plain from Guadalupe River and Coyote Creek. A portion of the area between the two streams is subject to flooding by overbanking of either the right bank of Guadalupe or left bank of Coyote Creek. Analysis of hydrological and historical flood data indicates that a substantial portion of flooding, especially from floods of high magnitude, in Reaches II and III would occur first from one stream, followed within a few days by flooding from the other. This is what occurred in 1958 when Guadalupe River flooded first. Flooding which occurs in this manner causes less damage than floods which occur at a greater interval of time; that is, occurring after rehabilitation of the flood plain. For example, flood damage in Reach II between Guadalupe River and Coyote Creek which would result from standard project floods occurring independently, is estimated to be:

Guadalupe River	\$2,030,000
Coyote Creek	<u>2,310,000</u>
Total	\$4,340,000

Were standard project floods to follow each other within a few days, the total damages would have been much less. Damage-frequency curves were plotted assuming independent flooding. For purposes of further analysis it was assumed that combined damages were equivalent to damage caused by a flood on the more damaging stream only, plus one-half the damages from the other less damaging stream flooding independently.

e. County improvements. Santa Clara County has improved the channel from Alviso to Bayshore Highway to provide protection from flood flows up to 12,000 c.f.s. Average annual damages (in September 1964 prices), both before and after the flood-control projects undertaken by Santa Clara County, are tabulated in Table B-4. The County project resulting in reducing damages from adjacent stream by 93 percent. Damages from Guadalupe River were reduced 35 percent. There are no county improvements on Coyote Creek.

f. Damages under existing conditions. Damages under existing conditions become existing damages for the purpose of this analysis of potential Corps projects. Damages were brought to December 1967 price levels by applying appropriate price indices and are tabulated in Table B-5. Average annual damages for Guadalupe River under existing conditions are \$289,000. Those for Coyote Creek are \$266,000. Those for all adjacent streams are only \$75,000 reflecting the probable effectiveness of county improvements.

g. Development factors. Flood-damage studies have indicated that future damages increase in proportion to the increase in economic activity within a given study area. The area under study is expected to expand during the next hundred years as described in a previous paragraph entitled "Economic Characteristics". As a result of this development, flood damages will be successively higher during future years. The increases in damages are expected to be proportional to increases in future value of land and improvement. Projected average annual future development factors are shown in Table B-6. The development factors for Coyote Creek, as well as for adjacent streams, are 1.3 for 50 years and 1.6 for 100 years. The development factors vary for different reaches of Guadalupe River, reflecting the lesser development anticipated in the upper reaches.

h. Damages under future conditions. Average annual damages under existing conditions shown in Table B-5 have been multiplied by future development factors to obtain the future damages for each basin. Average annual damages under December 1967 prices and future development are tabulated in Table B-7 and summarized below:

	<u>Future Damages</u>	
	<u>50-Year</u>	<u>100-Year</u>
Guadalupe River	\$358,000	\$436,000
Coyote Creek	\$346,000	\$425,000
Adjacent Streams	<u>\$ 97,000</u>	<u>\$121,000</u>
Total	\$765,000	\$998,000

These total damages include overlapping damages common to both the Guadalupe River Basin and the Coyote Creek Basin.

FLOOD BENEFIT ANALYSIS

B-10. PROCEDURE FOR BENEFIT ANALYSIS

Flood control benefits consist of the reduction in flood damages caused by stream overflow and land enhancement. Benefits due to flood-damage reduction creditable to the suggested plans of improvement were computed as the difference in damages with and without the suggested plan of improvement. Appropriate future development factors were applied to benefits under existing conditions to obtain benefits under future conditions. For purposes of computing benefits, total damages with and without the proposed plan of improvement were computed excluding overlapping flood damages in the common flood plain between Guadalupe River and Coyote Creek. Overlapping flood damages were assumed equal to the independent damages from the more damaging stream plus one-half of the independent damages from the less damaging stream. Because of the small effect of overlapping damages for Reach III, no adjustments were made in the benefit analysis.

B-11. FLOOD CONTROL BENEFITS

Flood control benefits from various plans of improvement considered are presented below:

- a. Guadalupe River only. Projects on Guadalupe River considered in this subparagraph assume Coyote Creek unimproved. All benefits are at December 1967 price levels.

(1) Channel works.

Benefits from plans of improvement on Guadalupe River mainstream and Los Gatos Creek consisting of levee protection against a one-percent flood and against the standard project flood are presented in Tables B-8 and B-9, respectively, and are summarized below:

	<u>Benefits</u>		
	<u>Existing Conditions</u>	<u>Future Conditions</u> <u>50-Year</u>	<u>100-Year</u>
One percent flood protection	\$127,000	\$161,000	\$193,000
Standard project flood protection	265,000	327,000	398,000

(2) Reservoir.

Benefits presented in Table B-10 are those resulting from modification of Lexington Reservoir to include 18,000 acre-feet of flood control storage to protect the area from Alviso to Branham Lane and The Alameda to Dry Creek on Los Gatos Creek. Average annual benefit under existing conditions total \$130,000. Benefits are \$166,000 and \$203,000 respectively for the 50- and 100-year periods.

b. Coyote Creek only.

Projects on Coyote Creek considered in this subparagraph assume Guadalupe River unprotected and assume Anderson and Coyote Dams operated under present procedures. Benefits are at December 1967 price levels.

(1) Channel works.

Benefits from improvement on Coyote Creek from Alviso to Story Road consisting of protection against a two percent flood, against a one percent flood and against the standard project flood are presented in Tables B-11, B-12, and B-13, respectively, and are summarized below:

	Existing Conditions	<u>Benefits</u>	
		50-Year	100-Year
Two percent flood protection	\$167,000	\$217,000	\$268,000
One percent flood protection	200,000	260,000	320,000
Standard project flood protection	242,000	315,000	387,000

(2) Reservoir.

Benefits for Coyote Creek Basin which would occur by assuming Coyote and Anderson Reservoirs under present operating procedures and with a plan of improvement consisting of 14,000 acre-feet of flood control storage available in Anderson Reservoir are presented in the following tabulation:

<u>Existing Damage 1/</u>	<u>Residual Damage</u>	<u>Existing Benefit</u>	<u>Future Benefit 50-Year/100-Year</u>	
\$266,000	\$165,000	\$101,000 *	\$131,000	\$162,000

1/ Includes all reaches

* The difference in combined damages in the common flood plain with and without the project would be equal to the benefit on Coyote Creek alone.

c. Combined projects, Guadalupe River and Coyote Creek.

Projects on one stream alone are somewhat limited in their effectiveness because they cannot affect damages from the other stream in common flood plain Reaches III and IV. For this reason benefits are computed for concurrent projects on both streams. Benefits are at December 1967 price levels.

(1) Additional benefits.

Benefits presented in the previous paragraph for Guadalupe River assume no project on Coyote Creek and visa versa with existing

protection on Guadalupe River. Because of the common flood plain in Reach II, additional benefits would accrue as a result of installing projects on both streams. These additional benefits are presented below. For combination not shown below, no additional benefits would accrue.

<u>Degree of Protection</u>	<u>Additional Benefits</u>	<u>Additional Future Benefits 50-Year/100-Year</u>	
Standard project flood on Coyote, Standard project flood on Guadalupe	\$24,000*	\$31,000	\$38,000
Standard project flood on Coyote, 1 percent on Guadalupe	14,000	18,000	22,000
Standard project flood, on Coyote, Lexington Reservoir on Guadalupe	14,000	18,000	22,000
1 percent on Coyote, Standard project flood on Guadalupe	11,000	14,000	18,000
1 percent on Coyote, 1 percent on Guadalupe	11,000	14,000	18,000
1 percent on Coyote, Lexington Reservoir on Guadalupe	11,000	14,000	18,000

* Example of derivation:

<u>Degree of Protection</u>	<u>Guadalupe</u>	<u>Coyote</u>	<u>Combined</u>	<u>Benefit</u>	<u>Additional Benefit</u>
Existing on both	\$49,000	\$135,000	\$160,000		
Existing on Coyote Creek, standard project flood on Guadalupe	0	135,000	135,000	\$ 25,000	
Standard project flood on Coyote, existing on Guadalupe	49,000	0	49,000	111,000	
Separable total				\$136,000	
Standard project flood on both streams	0	0	0	\$160,000	\$24,000

(2) Combined benefits.

Benefits (1) from a project on Coyote Creek assuming existing conditions on Guadalupe River plus (2) benefits from a project on Guadalupe River assuming Coyote unprotected, plus (3) additional benefits, if any, equal total benefits from projects in combination. There are 12 possible projects in combination. In order to avoid excess detail, benefits are shown for entire streams, instead of reaches, and only for projects in combination for which there are additional benefits. Benefits are shown in Table B-14. The most beneficial project in combination, standard project flood protection on both streams, yields average annual benefits of \$531,000 under existing conditions and \$673,000 and \$823,000 for the 50 and 100-year study periods, respectively.

d. Adjacent streams.

Benefits from improvements on adjacent streams consisting of protection against a two percent flood, against a one percent flood and against the standard project flood are presented in Tables B-15, B-16 and B-17, respectively, and are summarized below:

	<u>Benefits</u>		
	<u>Existing Conditions</u>	<u>Future Conditions: 50-Year</u>	<u>100-Year</u>
Two percent flood protection	\$38,000	\$49,000	\$62,000
One percent flood protection	61,000	79,000	98,000
Standard project flood protection	75,000	97,000	121,000

B-12. LAND ENHANCEMENT

Indications are that there will be no land enhancement benefit in the study area attributable to any Federal flood control project. This has been demonstrated by the continual development taking place throughout the area. In addition to current trends, the county has a master plan which delineates future development. The plan calls for reservation of certain agricultural areas for park and recreation purposes in the vicinity of Alviso. Any higher utilization of this land would, therefore, be precluded.

B-13. FLOOD PLAIN MANAGEMENT

Santa Clara County has no established regulations pertaining to developments in the flood plain. It is expected that a Flood Plain Information Study will be prepared for local interests.

B-14. SUMMARY OF FLOOD-CONTROL BENEFITS

Various plans of improvements considered would produce benefits under existing (December 1967 prices) and future conditions as shown in the following Summary of Benefits.

SUMMARY OF BENEFITS
(December 1967 Prices)

Type of Improvement	Existing Conditions	Future Conditions 50-Year/100-Year	
a. Guadalupe River alone			
1. Channel improvements on Guadalupe River			
Standard project flood	\$265,000	\$327,000	\$398,000
1 percent flood protection	127,000	161,000	193,000
2. Modification of Lexington Reservoir to include 18,000 acre- feet of flood control storage			
	130,000	166,000	203,000
b. Coyote Creek alone			
1. Channel improvements on Coyote Creek			
Standard project flood	242,000	315,000	387,000
1 percent flood protection	200,000	260,000	320,000
2 percent flood protection	167,000	217,000	268,000
2. Modification of Anderson Reservoir to include 14,000 acre-feet of flood control storage			
	101,000	131,000	162,000
c. Combined projects on Guadalupe River and Coyote Creek ^{1/}			
Standard project channel works on Coyote Creek in combination with protection on Guadalupe River as follow			
1. Standard project protection	531,000	673,000	823,000
2. One percent protection	383,000	494,000	602,000
3. Lexington Reservoir	386,000	499,000	612,000
One percent channel works on Coyote Creek in combination with protection on Guadalupe River as follow			
1. Standard project protection	476,000	601,000	736,000
2. One percent protection	338,000	435,000	531,000
3. Lexington Reservoir	341,000	440,000	541,000

^{1/} Combined benefits are presented only for projects in combination for which there are additional benefits. For other projects in combination, combined benefits are the sum of benefits considered separately.

(Cont'd)

SUMMARY OF BENEFITS

Type of Improvement	Existing Conditions	Future Conditions	
		Economic Life	
		50-Year	100-Year
d. Channel improvements on adjacent streams			
<u>Two Percent Flood</u>			
Matadero	0	0	0
Saratoga	0	0	0
Permanente	\$ 6,000	\$ 8,000	\$10,000
Calabazas	5,000	6,000	8,000
San Tomas Aquinas	0	0	0
Adobe	6,000	8,000	10,000
Barron	3,000	4,000	5,000
Stevens	<u>18,000</u>	<u>23,000</u>	<u>29,000</u>
Total	\$38,000	\$49,000	\$62,000
<u>One Percent Flood</u>			
Matadero	0	0	0
Saratoga	\$ 8,000	\$10,000	\$13,000
Permanente	7,000	9,000	11,000
Calabazas	6,000	8,000	10,000
San Tomas Aquinas	3,000	4,000	5,000
Adobe	7,000	9,000	11,000
Barron	4,000	5,000	6,000
Stevens	<u>26,000</u>	<u>34,000</u>	<u>42,000</u>
Total	\$61,000	\$79,000	~~\$98,000~~

(Cont'd)

SUMMARY OF BENEFITS

Type of Improvement	Existing Conditions	Future Conditions	
		Economic Life 50-Year/100-Year	
		<u>Standard Project Flood</u>	
Matadero	0	0	0
Saratoga	\$11,000	\$14,000	\$ 18,000
Permanente	8,000	10,000	13,000
Calabazas	6,000	8,000	10,000
San Tomas Aquinas	3,000	4,000	5,000
Adobe	7,000	9,000	11,000
Barron	4,000	5,000	6,000
Stevens	<u>36,000</u>	<u>47,000</u>	<u>58,000</u>
Total	\$75,000	\$97,000	\$121,000

TABLE B-1
POPULATION PROJECTIONS - 1960-2065
(In Thousands)

Basin	1960 ^{1/}	1965 ^{2/}	1975	1985	1995	2005	2015	2065
Guadalupe	244	311	466	580	690	780	850	1,000
Coyote	126	139	154	170	180	190	195	210
Adjacent Streams	236	336	550	720	850	950	1,025	1,150
Total	606	786	1,170	1,470	1,720	1,920	2,070	2,360
Santa Clara County ^{3/}	642	894	1,350	1,720	2,050	2,340	2,500	3,140

^{1/} U.S. Census of population - 1960.

^{2/} Based upon estimates of the State Department of Finance.

^{3/} Based upon projections of the State Department of Water Resources, 1960-2005 and curvilinear extrapolation to 2065.

TABLE B-2

HISTORICAL DAMAGES
(September 1954 Prices)

Floods of December 1955 - January 1956

Drainage Basin and Stream	Discharge (c.f.s.)	Area Flooded (Acres)	Damages
<u>Adjacent streams</u>			
Matadero	850	102	\$ 88,000
Saratoga	2,730	4,210	1,050,000
San Tomas Aquinas	2,000	1,770	282,000
Stevens	2,700	1,325	482,000
Permanente	2,000	770	171,000
Adobe	1,300	118	107,000
Calabazas	1,900	110	390,000
Total, Adjacent Streams		8,735	\$2,570,000
Coyote Creek	3,000	2,302	66,000
Penitencia	2,000	102	70,000
Total, Coyote Creek		2,704	\$ 136,000
<u>Guadalupe River</u>			
Reach II			
Right bank	5,570	3,428	\$ 605,000
Left bank	5,570	112	64,000
Subtotal Reach II		3,840	\$ 669,000
Reach III			
Right bank	5,570	747	\$ 32,000
Left bank	5,570	163	53,000
Subtotal Reach III		1,210	\$ 85,000
Reach IV	5,570	20	\$ 70,000
Reach V	5,570	15	3,000
Reach VI	5,570	205	103,000
Subtotal Reaches IV, V & VI		240	\$ 176,000
Reach VII, Los Gatos Creek	5,570	1,160	\$ 250,000
Total, Guadalupe River		6,750	\$1,180,000

TABLE B-2
(Cont'd)

HISTORICAL DAMAGES
(September 1964 Prices)
Floods of April 1958

Drainage Basin and Stream	Discharge (c.f.s.)	Area Flooded (Acres)	Damages
<u>Guadalupe River</u>			
Reach II			
Right bank	9,150	1,940	\$ 829,000
Left bank	9,150	670	331,000
Subtotal Reach II		2,610	\$1,160,000
Reach III			
Right bank	9,150	530	\$ 39,000
Left bank	9,150	740	54,000
Subtotal Reach III		1,270	\$ 93,000
Reach IV	9,150	135	\$ 329,000
Reach V	9,150	50	17,000
Subtotal Reaches IV & V		185	\$ 343,000
Total, Guadalupe River		4,065	\$1,600,000
<u>Flood of January 1963</u>			
<u>Guadalupe River</u>			
Reach II			
Right bank	6,300	1,505	\$ 220,000
Left bank	6,300	530	76,000
Subtotal Reach II		2,035	\$ 296,000
Reach III			
Right bank	6,300	150	\$ 13,000
Left bank	6,300	-	-
Subtotal Reach III		150	\$ 13,000
Reach IV	6,300	Bank erosion	\$ 24,000
Total, Guadalupe River		2,185	\$ 335,000

TABLE B-2
(Cont'd)

HISTORICAL DAMAGES
(September 1964 Prices)

Floods of April 1958

Drainage Basin and Stream	Discharge (c.f.s.)	Area Flooded (Acres)	Damages
<u>Adjacent Streams</u>			
Matadero	670	N.R. ^{1/}	\$ 37,000
Saratoga	770	1,650	97,000
San Tomas Aquinas	1,100	600	105,000
Stevens	2,300	Bank erosion	11,000
Permanente	1,100	N.R. ^{1/}	<u>100,000</u>
Total, Adjacent Streams			\$350,000
<u>Coyote Creek</u>			
Reach II			
Right bank	6,900	-	-
Left bank	6,900	<u>1,925</u>	<u>\$226,000</u>
Subtotal Reach II		1,925	\$226,000
Reach III			
Right bank	6,900	-	-
Left bank	6,900	<u>490</u>	<u>\$ 91,000</u>
Subtotal Reach III		490	\$ 91,000
<u>Penitencia Creek</u>	1,400	<u>200</u>	<u>\$ 18,000</u>
Total, Coyote Creek		2,100	\$365,000

^{1/} Not reported.

TABLE B-3

STANDARD PROJECT FLOOD DAMAGES ^{1/}
(September 1964 Prices and Conditions)

Drainage Basin and Stream	Reference Discharge (c.f.s.)	Area Flooded (Acres)	Damages
<u>Coyote Creek</u> ^{2/}			
Reach II			
Right bank	30,500	1,040	\$ 692,000
Left bank	30,500	3,370	2,308,000
Subtotal, Reach II		4,410	\$3,000,000
Reach III			
Right bank	30,500	355	\$ 190,000
Left bank	30,500	1,520	810,000
Subtotal, Reach III		1,875	\$1,000,000
Reach IV	30,500	700	\$ 400,000
Reach V	30,500	470	160,000
Reach VI	30,500	545	120,000
Total, Coyote Creek		9,190	\$4,810,000
<u>Guadalupe River</u>			
Reach II			
Right bank	30,000	2,953	\$2,030,000
Left bank	30,000	882	970,000
Subtotal Reach II		3,835	\$3,000,000
Reach III			
Right bank	30,000	680	\$ 160,000
Left bank	30,000	1,435	340,000
Subtotal Reach III		2,115	\$ 500,000
Reach IV	30,000	1,415	\$ 500,000
Reach V	30,000	1,850	5,000,000
Reach VI	14,000	1,440	5,200,000
Reach VII, Los Gatos Creek	16,000	580	2,100,000
Total, Guadalupe River		11,235	\$16,300,000

- ^{1/} No standard project flood plains were developed for the adjacent streams.
- ^{2/} The Coyote Creek and Guadalupe River flood plain overlap in Reaches II and III as shown by comparing Plates B-2 and B-3. The damages presented assume that the floods occur independently over time.
- ^{3/} Standard project flood discharge at the point for which discharge-frequency curves were derived.

AVERAGE ANNUAL DAMAGES BEFORE AND AFTER COUNTY PROJECT (PRESENT CONDITIONS)
(September 1964 Prices)

Drainage Basin and Stream	Damages	
	Before County Project	After County Project (Existing Conditions)
<u>Guadalupe River</u>		
Reach II		
Right bank	\$154,000	\$ 44,000
Left bank	<u>76,000</u>	<u>23,000</u>
Subtotal Reach II	\$230,000	\$ 67,000
Reach III		
Right bank	\$ 11,000	\$ 3,000
Left bank	<u>14,000</u>	<u>6,000</u>
Subtotal Reach III	\$ 25,000	\$ 9,000
Reach IV	\$ 37,000	\$ 25,000
Reach V	85,000	85,000
Reach VI	63,000	63,000
Reach VII Los Gatos Creek	<u>13,000</u>	<u>13,000</u>
Total, Guadalupe River	\$453,000	\$262,000
<u>Coyote Creek</u>		
Reach II		
Right bank	\$ 37,000	\$ 37,000
Left bank	<u>123,000</u>	<u>123,000</u>
Subtotal Reach II	\$160,000	\$160,000
Reach III		
Right bank	\$ 9,000	\$ 9,000
Left bank	<u>34,000</u>	<u>34,000</u>
Subtotal Reach III	\$ 43,000	\$ 43,000
Reach IV	\$ 20,000	\$ 20,000
Reach V	15,000	15,000
Reach VI	<u>4,000</u>	<u>4,000</u>
Total, Coyote Creek	\$242,000	\$242,000
Total, Coyote Creek and Guadalupe River ^{1/}	\$629,000	\$481,000
^{1/} Damages exclude overlapping flood damages in the common flood plain between Guadalupe River and Coyote Creek, Reaches II and III. Overlapping flood damages are equal to independent damages on the more damaging stream plus one half of independent damages on the other, less damaging stream.		

TABLE B-4
(Cont'd)

AVERAGE ANNUAL DAMAGES BEFORE AND AFTER COUNTY PROJECT (September 1964 Prices)

Drainage Basin and Stream	Damages	
	Before County Project	After County Project (Including Conflicts)
<u>Adjacent Streams</u>		
Matadero	\$ 147,000	\$ 0
Saratoga	250,000	10,000
Permanente	126,000	7,000
Calabazas	91,000	5,000
San Tomas Aquinas	169,000	3,000
Adobe	72,000	6,000
Barron	10,000	4,000
Stevens	<u>171,000</u>	<u>33,000</u>
Total, Adjacent Streams	\$1,036,000	\$ 68,000
Total, all streams <u>1/</u>	\$1,665,000	\$549,000
<u>1/</u> See previous page.		

TABLE L-5

AVERAGE ANNUAL DAMAGES
(December 1967 Prices and Conditions)

Drainage Basin and Stream	Existing Damages
<u>Guadalupe River</u>	
Reach II	
Right bank	\$ 49,000
Left bank	<u>25,000</u>
Subtotal Reach II	\$ 74,000
Reach III	
Right bank	\$ 3,000
Left bank	<u>7,000</u>
Subtotal Reach III	\$ 10,000
Reach IV	\$ 28,000
Reach V	94,000
Reach VI	69,000
Reach VII	<u>17,000</u>
Total, Guadalupe River	\$289,000
<u>Coyote Creek</u>	
Reach II	
Right bank	\$ 41,000
Left bank	<u>135,000</u>
Subtotal Reach II	\$176,000
Reach III	
Right bank	\$ 10,000
Left bank	<u>37,000</u>
Subtotal Reach III	\$ 47,000
Reach IV	\$ 22,000
Reach V	17,000
Reach VI	<u>7,000</u>
Total, Coyote Creek	\$266,000

TABLE B-5
(Cont'd)

AVERAGE ANNUAL DAMAGES
(December 1967 Prices and Conditions)

Drainage Basin and Stream	Existing Damages
<u>Adjacent Streams</u>	
Matadero	\$ 0
Saratoga	11,000
Permanente	8,000
Calabazas	6,000
San Tomas Aquinas	3,000
Adobe	7,000
Barron	4,000
Stevens	3,000
Subtotal Adjacent Streams	\$ 75,000
Total, all streams 1/	\$603,000
1/ Total damages exclude overlapping damages of \$25,000 in the common flood plain between Guadalupe River and Coyote Creek, reaches II and IV	

TABLE B-6

DEVELOPMENT FACTORS

Drainage Basin and Stream	Development Factors	
	50-Year Analysis	100-Year Analysis
<u>Guadalupe River</u>		
Reach II		
Right bank	1.3	1.6
Left bank	1.3	1.6
Reach III		
Right bank	1.3	1.6
Left bank	1.3	1.6
Reach IV	1.3	1.5
Reach V	1.3	1.6
Reach VI	1.1	1.3
Reach VII	1.1	1.4
<u>Coyote Creek</u>		
All Reaches	1.3	1.6
<u>Adjacent Streams</u>		
Saratoga	1.3	1.6
Permanente	1.3	1.6
Calabazas	1.3	1.6
San Tomas Aquinas	1.3	1.6
Adobe	1.3	1.6
Barron	1.3	1.6
Stevens	1.3	1.6
Matadero	1.3	1.6

TABLE B-7

FUTURE AVERAGE ANNUAL DAMAGES
(December 1967 Prices and Future Conditions)

Drainage Basin and Stream	Existing Damages Dec. 1967 Prices	Future Damages			
		50-Year		100-Year	
		Development Factor	Damages	Development Factor	Damages
<u>Guadalupe River</u>					
Reach II					
Right bank	\$ 49,000	1.3	\$ 64,000	1.6	\$ 78,000
Left bank	<u>25,000</u>	1.3	<u>32,000</u>	1.6	<u>40,000</u>
Subtotal	\$ 74,000		\$ 96,000		\$118,000
Reach III					
Right bank	\$ 3,000	1.3	\$ 4,000	1.6	\$ 5,000
Left bank	<u>7,000</u>	1.3	<u>9,000</u>	1.6	<u>11,000</u>
Subtotal	\$ 10,000		\$ 13,000		\$ 16,000
Reach IV	\$ 28,000	1.3	\$ 36,000	1.5	\$ 42,000
Reach V	94,000	1.3	122,000	1.6	150,000
Reach VI	69,000	1.1	76,000	1.3	90,000
Reach VII	<u>14,000</u>	1.1	<u>15,000</u>	1.4	<u>20,000</u>
Total	\$289,000		\$358,000		\$436,000
<u>Coyote Creek</u>					
Reach II					
Right bank	\$ 41,000	1.3	\$ 53,000	1.6	\$ 66,000
Left bank	<u>135,000</u>	1.3	<u>176,000</u>	1.6	<u>216,000</u>
Subtotal	\$176,000		\$229,000		\$282,000
Reach III					
Right bank	\$ 10,000	1.3	\$ 13,000	1.6	\$ 16,000
Left bank	<u>37,000</u>	1.3	<u>48,000</u>	1.6	<u>59,000</u>
Subtotal	\$ 47,000		\$ 61,000		\$ 75,000
Reach IV	\$ 22,000	1.3	\$ 29,000	1.6	\$ 35,000
Reach V	17,000	1.3	22,000	1.6	27,000
Reach VI	4,000		5,000		6,000
Total	\$266,000		\$346,000		\$445,000

TABLE B-7
(Cont'd)

FUTURE AVERAGE ANNUAL DAMAGES
(December 1967 Prices and Future Conditions)

Drainage Basin and Stream	Existing Damages	Future Damages			
	Dec. 1967 Prices	50-Year Development Factor	50-Year Damages	100-Year Development Factor	100-Year Damages
<u>Adjacent Streams</u>					
Matadero	0	1.3	0	1.6	0
Saratoga	\$ 11,000	1.3	\$ 14,000	1.6	\$ 18,000
Permanente	8,000	1.3	10,000	1.6	13,000
Calabazas	6,000	1.3	8,000	1.6	10,000
San Tomas					
Aquinas	3,000	1.3	4,000	1.6	5,000
Adobe	7,000	1.3	9,000	1.6	11,000
Barron	4,000	1.3	5,000	1.6	6,000
Stevens	<u>36,000</u>	1.3	<u>47,000</u>	1.6	<u>58,000</u>
Total	\$ 75,000		\$ 97,000		\$121,000
Total, all Basins <u>1/</u>	\$603,000		\$765,000		\$936,000
<u>1/</u> Total damages exclude overlapping damages occurring in the common flood plain between Guadalupe River and Coyote Creek, reaches II and III.					

TABLE B-8.

PROJECT BENEFITS, GUADALUPE RIVER CHANNEL WORKS
ONE PERCENT FLOOD PROTECTION
 (December 1937 Prices)

Reach	Existing Damage	Residual Damage	BENEFIT, Existing Conditions	BENEFIT, FUTURE Conditions 50-Year/100-Year
II				
Right bank	\$ 49,000	\$ 20,000	\$ 15,000 *	\$ 20,000
Left bank	<u>25,000</u>	<u>11,000</u>	<u>14,000</u>	<u>18,000</u>
Subtotal, II	\$ 74,000	\$ 31,000	\$ 29,000	\$ 38,000
III	10,000	4,000	6,000	8,000
IV	28,000	16,000	12,000	16,000
V	94,000	42,000	52,000	68,000
VI	69,000	42,000	27,000	30,000
VII	<u>14,000</u>	<u>13,000</u>	<u>1,000</u>	<u>1,000</u>
Total	\$289,000	\$148,000	\$127,000	\$161,000
* Computed as follows:				
<u>Condition</u>	<u>Guadalupe River Right Bank</u>	<u>Coyote Creek Left Bank</u>	<u>Combined</u>	
Existing conditions on Coyote and Guadalupe	\$49,000	\$135,000	\$160,000	
1 percent pro- tection on Guadalupe, no protection on Coyote	\$20,000	\$135,000	<u>\$155,000</u>	
Benefit			\$ 15,000	

TABLE B-9

PROJECT BENEFITS, GUADALUPE RIVER CHANNEL WORKS
STANDARD PROJECT FLOOD PROTECTION
 (December 1967 Prices)

Reach	Existing Damage	Residual Damage	Benefit, Existing Conditions	Benefit, Future Conditions 50-Year/100-Year	
II					
Right bank	\$ 49,000	-	\$ 25,000*	\$ 32,500	\$ 40,000
Left bank	25,000	-	25,000	32,500	40,000
Subtotal, II	\$ 74,000		\$ 50,000	\$ 65,000	\$ 80,000
III	10,000	-	10,000	13,000	16,000
IV	28,000	-	28,000	36,000	42,000
V	94,000	-	94,000	122,000	150,000
VI	69,000	-	69,000	76,000	90,000
VII	14,000	-	14,000	15,000	20,000
Total	\$289,000	-	\$265,000	\$327,000	\$398,000
*Computed as follows:					
<u>Condition</u>	<u>Guadalupe River Right Bank</u>	<u>Coyote Creek Left Bank</u>	<u>Combined</u>		
Existing condi- tions on Coyote and Guadalupe	\$49,000	\$135,000	\$160,000		
Standard project flood on Guadalupe; no protection on Coyote	0	135,000	135,000		
Benefit			\$ 25,000		

TABLE B-10

PROJECT BENEFITS, LEXINGTON RESERVOIR, GUADALUPE RIVER
18,000 ACRE-FEET OF FLOOD CONTROL STORAGE
 (December 1967 Prices)

Reach	Existing Damage	Residual Damage	Benefit, Existing Conditions	Benefit, Future Conditions 50-Year/100-Year	
II					
Right bank	\$ 49,000	\$ 20,000	\$ 15,000*	\$ 20,000	\$ 21,000
Left bank	<u>25,000</u>	<u>11,000</u>	<u>13,000</u>	<u>18,000</u>	<u>22,000</u>
Subtotal, II	\$ 74,000	\$ 31,000	\$ 29,000	\$ 38,000	\$ 46,000
III	10,000	3,000	7,000	9,000	11,000
IV	28,000	9,000	19,000	25,000	28,000
V	94,000	33,000	61,000	79,000	98,000
VI	69,000	69,000	-	-	-
VII	<u>14,000</u>	<u>0</u>	<u>14,000</u>	<u>15,000</u>	<u>20,000</u>
Total	\$289,000	\$145,000	\$130,000	\$166,000	\$203,000

* Computed as in Table B-7 for one percent, channel work protection.

TABLE B-21

PROJECT BENEFITS, COYOTE CREEK CHANNEL WORKS
TWO PERCENT FLOOD PROTECTION
 (December 1967 Prices)

Reach	Existing Damage	Residual Damage	Benefit; Existing Condition	Benefit, Future Conditions 50-Year/100-Year	
II					
Right bank	\$ 41,000	\$ 14,000	\$ 27,000	\$ 35,000	\$ 43,000
Left bank	<u>135,000</u>	<u>50,000</u>	<u>85,000*</u>	<u>111,000</u>	<u>136,000</u>
Subtotal, II	\$176,000	\$ 64,000	\$112,000	\$146,000	\$179,000
III	47,000	19,000	28,000	36,000	45,000
IV	22,000	9,000	13,000	17,000	21,000
V	17,000	4,000	13,000	17,000	21,000
VI	<u>4,000</u>	<u>3,000</u>	<u>1,000</u>	<u>1,000</u>	<u>2,000</u>
Total	\$266,000	\$ 99,000	\$167,000	\$217,000	\$268,000
* Computed as follows:					
<u>Condition</u>	<u>Damage-Guadalupe River Right Bank</u>	<u>Damage-Coyote Creek Left Bank</u>	<u>Combined Damage</u>		
Existing conditions on Coyote and Guadalupe	\$49,000	\$135,000	\$160,000		
2 percent on Coyote; exist- ing protection on Guadalupe	\$49,000	\$ 50,000	<u>\$ 75,000</u>		
Benefit			\$ 85,000		

The difference in the combined damages in the common flood plain with and without the project would be equal to the benefit on Coyote Creek alone.

TABLE B-12

PROJECT BENEFITS, COYOTE CREEK CHANNEL WORKS
ONE PERCENT FLOOD PROTECTION
(December 1967 Prices)

Reach	Existing Damage	Residual Damage	Benefits, Existing Conditions	Benefits, Future Conditions - 10-Year/100-Year	
II					
Right bank	\$ 41,000	\$ 8,000	\$ 33,000	\$ 43,000	\$ 53,000
Left bank	<u>135,000</u>	<u>26,000</u>	<u>98,000*</u>	<u>126,000</u>	<u>156,000</u>
Subtotal, II	\$176,000	\$ 34,000	\$131,000	\$169,000	\$209,000
III	47,000	12,000	35,000	46,000	50,000
IV	22,000	6,000	16,000	21,000	26,000
V	17,000	2,000	15,000	20,000	24,000
VI	<u>4,000</u>	<u>1,000</u>	<u>3,000</u>	<u>4,000</u>	<u>5,000</u>
Total	\$266,000	\$ 55,000	\$200,000	\$260,000	\$320,000
* Computed as follows:					
<u>Condition</u>	<u>Damage-Guadalupe River Right Bank</u>	<u>Damage-Coyote Creek Left Bank</u>	<u>Combined Damage</u>		
Existing conditions on Coyote and Guadalupe	\$49,000	\$135,000	\$160,000		
One percent on Coyote; exist- ing protection on Guadalupe	\$49,000	\$ 26,000	<u>\$ 62,000</u>		
Benefit			\$ 98,000		

TABLE B-13

PROJECT BENEFITS, COYOTE CREEK CHANNEL WORKS
STANDARD PROJECT FLOOD PROTECTION
 (December 1967 Prices)

Reach	Existing Damage	Residual Damage	Benefit, Existing Conditions	Benefit, Future Conditions 50-Year/100-Year	
II					
Right bank	\$ 41,000	-	\$ 41,000	\$ 53,000	\$ 66,000
Left bank	<u>135,000</u>	-	<u>111,000*</u>	<u>145,000</u>	<u>178,000</u>
Subtotal, II	\$176,000		\$152,000	\$198,000	\$244,000
III	47,000	-	47,000	61,000	75,000
IV	22,000	-	22,000	29,000	35,000
V	17,000	-	17,000	22,000	27,000
VI	<u>4,000</u>	-	<u>4,000</u>	<u>5,000</u>	<u>6,000</u>
Total	\$266,000		\$242,000	\$315,000	\$387,000
* Computed as follows:					
<u>Condition</u>	<u>Damage-Guadalupe River Right Bank</u>	<u>Damage-Coyote Creek Left Bank</u>	<u>Combined Damage</u>		
Existing conditions on Coyote and Guadalupe	\$49,000	\$135,000	\$160,000		
Standard project flood on Coyote; existing protec- tion on Guadalupe	\$49,000	0	<u>\$ 49,000</u>		
Benefit			\$111,000		

TABLE B-14

PROJECT BENEFITS, GUADALUPE RIVER AND COYOTE CREEKPROJECTS IN COMBINATION
(December 1967 Prices)
(In Thousand Dollars)

Conditions	Benefits, Existing Conditions	Benefit, Future Conditions 50-Year/100-Year	
Standard project protection on Coyote			
Standard project protection on Guadalupe	531	673	823
Standard project protection on Coyote			
One percent protection on Guadalupe	383	494	602
Standard project protection on Coyote			
Lexington Reservoir on Guadalupe	386	499	612
One percent protection on Coyote			
Standard project protection on Guadalupe	476	601	736
One percent protection on Coyote			
One percent protection on Guadalupe	338	435	531
One percent protection on Coyote			
Lexington Reservoir on Guadalupe	341	440	541

TABLE B-15

PROJECT BENEFITS, ADJACENT STREAMS CHANNEL WORKS
TWO PERCENT FLOOD PROTECTION
 (December 1957 Prices)

Stream	Existing Damage	Residual Damage	Benefit, Existing Conditions	Benefit, Future Conditions	
				50-Year	100-Year
Matadero	0	0	0	0	0
Saratoga	\$11,000	\$11,000	0	0	0
Permanente	8,000	2,000	6,000	\$ 8,000	\$10,000
Calabazas	6,000	1,000	5,000	6,000	8,000
San Tomas Aquinas	3,000	3,000	0	0	0
Adobe	7,000	1,000	6,000	8,000	10,000
Barron	4,000	1,000	3,000	4,000	5,000
Stevens	<u>36,000</u>	<u>18,000</u>	<u>18,000</u>	<u>23,000</u>	<u>29,000</u>
Total	\$75,000	\$37,000	\$38,000	\$49,000	\$62,000

TABLE B-16

PROJECT BENEFITS, ADJACENT STREAMS CHANNEL WORKS
ONE PERCENT FLOOD PROTECTION
 (December 1987 Prices)

Stream	Existing Damage	Residual Damage	Benefit, Existing Conditions	Benefit, Future Conditions	
				50-Year	100-Year
Matadero	0	0	0	0	0
Saratoga	\$11,000	\$ 3,000	\$ 8,000	\$10,000	\$13,000
Permanente	8,000	1,000	7,000	9,000	11,000
Calabazas	6,000	0	6,000	8,000	10,000
San Tomas Aquinas	3,000	0	3,000	4,000	5,000
Adobe	7,000	0	7,000	9,000	11,000
Barron	4,000	0	4,000	5,000	6,000
Stevens	<u>36,000</u>	<u>10,000</u>	<u>26,000</u>	<u>34,000</u>	<u>42,000</u>
Total	\$75,000	\$14,000	\$61,000	\$79,000	\$98,000

TABLE B-17

PROJECT BENEFITS, ADJACENT STREAMS CHANNEL WORKS
STANDARD PROJECT FLOOD PROTECTION
 (December 1967 Prices)

Stream	Existing Damage	Residual Damage	Benefit, Existing Conditions	Benefit, Future Conditions	
				50-Year	100-Year
Matadero	0	0	0	0	0
Saratoga	\$11,000	0	\$11,000	\$14,000	\$ 18,000
Permanente	8,000	0	8,000	10,000	13,000
Calabazas	6,000	0	6,000	8,000	10,000
San Tomas Aquinas	3,000	0	3,000	4,000	5,000
Adobe	7,000	0	7,000	9,000	11,000
Barron	4,000	0	4,000	5,000	6,000
Stevens	<u>36,000</u>	<u>0</u>	<u>36,000</u>	<u>47,000</u>	<u>58,000</u>
Total	\$75,000	0	\$75,000	\$97,000	\$121,000

REPORT OF SURVEY
ON
GUADALUPE RIVER AND ADJACENT STREAMS
FOR
FLOOD CONTROL AND ALLIED PURPOSES

SANTA CLARA AND ALAMEDA COUNTIES
CALIFORNIA

APPENDIX C

ESTIMATES OF COSTS AND ANNUAL CHARGES

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	INTRODUCTION	
C-1	PURPOSE	C-1
C-2	SCOPE	C-1
C-3	DESIGN CRITERIA	C-2
C-4	DESCRIPTION OF IMPROVEMENTS CONSIDERED	C-2
	ESTIMATED FIRST COST	
C-5	BASES OF COST ESTIMATE	C-2
C-6	DETAILED COST ESTIMATES OF CONSIDERED IMPROVEMENTS	C-3
	ESTIMATES OF ANNUAL CHARGES	
C-7	INTEREST RATE	C-8
C-8	INITIAL INVESTMENT	C-8
C-9	ANNUAL INTEREST AND AMORTIZATION CHARGES	C-8
C-10	ANNUAL MAINTENANCE, OPERATION AND REPLACEMENT CHARGES	C-9
C-11	SUMMARY OF ANNUAL CHARGES	C-10
	TABLES	
C-1	COST ESTIMATE - GUADALUPE RIVER AND LOS GATOS CREEK	
C-2	COST ESTIMATE - COYOTE CREEK	

REPORT OF SURVEY
ON
GUADALUPE RIVER AND ADJACENT STREAMS
FOR
FLOOD CONTROL AND ALLIED PURPOSES
SANTA CLARA AND ALAMEDA COUNTIES
CALIFORNIA

APPENDIX C

ESTIMATES OF COSTS AND ANNUAL CHARGES

INTRODUCTION

C-1. PURPOSE

The purpose of this appendix is to present the itemized estimates of costs and annual charges for the investigated plans of improvement presented in the main report.

C-2. SCOPE

The investigated plans considered for flood control of the Guadalupe River and Coyote Creek consisted of levees and channel improvement to provide protection in each case against standard project flood discharge. Specifics of each plan of improvement are given in the main report. This appendix gives details of estimated first costs and estimated annual charges for these two major streams. The minor adjacent streams were found economically infeasible for improvement at a preliminary stage of the study. Therefore no presentation of minor streams cost is included in this appendix.

C-3. DESIGN CRITERIA

Criteria and data for hydraulic design of improvements considered are presented in Appendix A, Hydrology and Hydraulics Analysis.

C-4. DESCRIPTION OF IMPROVEMENTS CONSIDERED

For the Guadalupe River the considered improvements would consist of a trapezoidal channel with levees and concrete lined drop structures from the mouth of the river to Interstate Highway 280, a rectangular concrete channel to West Alma Avenue, and a trapezoidal earth channel with riprapped sides to Branham Avenue. The overall length of improved channel would be about 18 miles. Details of the plan of improvement for Guadalupe River are shown on Plate A-9. Los Gatos Creek improvements which are an integral part of the Guadalupe River plan of improvement, were considered from its confluence with Guadalupe River for a distance of about two miles. The improvements, which are shown in detail on Plate A-10, would consist of about one mile of rectangular concrete channel in the lower half and trapezoidal earth channel with riprapped sides for the remaining length. For Coyote Creek the considered improvements would consist of a trapezoidal earth channel with riprapped sides and levees on both sides of the creek for a distance of about 11 miles, and a rectangular concrete channel for a distance of approximately 3 miles. Pertinent details are shown on Plate A-11.

ESTIMATED FIRST COST

C-5. BASES OF COST ESTIMATE

Cost estimates presented in this report are considered adequate for project analysis and are based on December 1967 price levels.

All estimates include allowance for contingencies, engineering, design, supervision and administration in accordance with criteria specified in applicable engineering manuals. Adopted unit prices are based on: (a) bid prices for similar type work, adjusted to reflect local conditions; (b) information received from local suppliers of construction materials; and, (c) estimated costs developed by analysis of equipment, material and labor components required for construction. Real estate costs were based on the average value of land over the length of the considered improvements.

C-6. DETAILED COST ESTIMATES OF CONSIDERED IMPROVEMENTS

The estimated first cost of considered improvements for the Guadalupe River is \$42,000,000 of which the Federal cost is \$33,000,000 and the non-Federal cost is \$9,000,000. The estimated first cost of the considered improvements for Coyote Creek is \$35,000,000 of which the Federal cost is \$25,000,000 and the non-Federal cost is \$10,000,000. Details of the estimated cost are given in the following Tables C-1 and C-2, respectively:

TABLE C-1

COST ESTIMATE
GUADALUPE RIVER AND LOS GATOS CREEK

Item No.	Item	Quantity	Unit	Unit Price	Subtotal	Total
FEDERAL COST						
Channels, Conduits and Levees						
1.	Diversion & control of water	1	Job	L.S.	\$ 90,000	
2.	Clearing & grubbing	350	Acres	\$500.00	175,000	
3.	Stripping to waste	114,000	C.Y.	.55	62,700	
4.	Excavation common	3,388,000	C.Y.	.90	3,049,200	
5.	Dredge to waste	4,128,000	C.Y.	.80	3,302,400	
6.	Embankment					
	(a) Levee	1,583,000	C.Y.	.35	554,100	
	(b) Retaining dike	480,000	C.Y.	.30	144,000	
7.	Structural backfill	144,000	C.Y.	2.25	324,000	
8.	Surplus material, spoil	442,000	C.Y.	.30	132,600	
9.	Derrick stone	850	Ton	9.25	7,900	
10.	Riprap	661,000	Ton	7.00	4,627,000	
11.	Filter material	432,000	Ton	3.75	1,620,000	
12.	Concrete					
	(a) Walls & footings	36,000	C.Y.	60.00	2,160,000	
	(b) Slab	131,000	C.Y.	32.00	4,192,000	
13.	Reinforcing steel	8,350	Ton	300.00	2,505,000	
14.	Drain 6" CMP	36,000	L.F.	2.90	104,400	
15.	Flap Gates 6"	183	Each	125.00	22,900	
16.	Manholes	36	Each	500.00	18,000	
17.	Fence 6" chain link	36,000	L.F.	2.00	72,000	
18.	SPCo. Trestle					
	Station 212+ Single track	425	L.F.	210.00	89,300	
19.	SPCo. Trestle					
	Station 625+ 4 tracks	105	L.F.	1,050.00	110,300	
20.	SPCo. Trestle					
	Station 717+ Single track	80	L.F.	210.00	16,800	
21.	WPRR Trestle					
	Station 757+ Single track	70	L.F.	210.00	14,700	
	Subtotal				23,354,300	
	Contingencies				4,605,700	
	Total, Federal construction cost					\$28,000,000
	Engineering and Design					(3,000,000)
	Supervision and Administration					2,000,000
	Federal Project first cost					\$33,000,000

TABLE C-1 (Continued)

Item No.	Item	Quantity	Unit	Unit Price	Subtotal	Total
NON-FEDERAL COST						
A.	<u>Lands, Easements and Rights-of-way</u>					
1.	Lands & improvements				\$6,000,000	
	Contingencies				300,000	
	Cost of acquisition				<u>300,000</u>	
	Total, lands, etc.				\$6,600,000	
B.	<u>Bridges</u>					
1.	Willow Glen Way Bridge, Station 772± 2 lanes	170	L.F.	\$1,190.00	\$ 202,300	
2.	Curtner Ave. Bridge, Reach 2 Station 819± 4 lanes	160	L.F.	1,890.00	302,400	
3.	Private Rd & Bridge, Station 859± Single lane	145	L.F.	1,190.00	<u>172,600</u>	
4.	Hillsdale Ave. Bridge, Station 880± 2 lanes	170	L.F.	1,190.00	202,300	
5.	Steval Dr. Bridge, Station 890± 2 lanes	145	L.F.	1,190.00	172,600	
6.	Crossing Bridge, Station 903± 2 lanes	150	L.F.	1,190.00	178,500	
7.	Bryan Ave. Bridge, Station 914± 2 lanes	150	L.F.	1,190.00	178,500	
8.	Branham Ave. Bridge, Station 935± 4 lanes	140	L.F.	1,890.00	<u>264,600</u>	
	Subtotal				<u>1,073,000</u>	
	Contingencies				<u>326,200</u>	
	Subtotal, bridges				\$2,000,000	
	Engineering & Design, Supervision & Administration				<u>400,000</u>	
	Total, bridges				\$2,400,000	
	Total, non-Federal project cost					<u>\$ 9,000,000</u>
	TOTAL, PROJECT FIRST COST					\$42,000,000

TABLE C-2

COST ESTIMATE
COYOTE CREEK

Item No.	Item	Quantity	Unit	Unit Price	Subtotal	Total
FEDERAL COST						
Channels, Conduits and Levees						
1.	Clearing & grubbing	450	Acres	\$500.00	\$ 225,000	
2.	Stripping to waste	372,000	C.Y.	.55	204,600	
3.	Excavation	5,990,000	C.Y.	.90	5,391,000	
4.	Embankment					
	(a) Levee	763,000	C.Y.	.35	267,100	
5.	Waste disposal (2 miles)	4,840,000	C.Y.	.30	1,452,000	
6.	Structural backfill -					
	compacted	553,000	C.Y.	2.25	1,244,300	
7.	Bedding material	189,000	Ton	4.25	803,300	
8.	Riprap 12" rock	420,000	Ton	7.00	2,940,000	
9.	Filter material	104,000	Ton	3.75	390,000	
10.	Drains 6" CMP perforated	39,000	L.F.	2.90	113,100	
11.	6" flap gates	100	Each	125.00	12,500	
12.	Concrete	62,000	C.Y.	50.00	3,100,000	
13.	Reinforcing steel	3,100	Ton	300.00	930,000	
14.	Road Gravel	17,000	Ton	4.50	76,500	
15.	Western Pacific Railroad S-1 Br.	120	L.F.	210.00	25,200	
16.	Southern Pacific Railroad Br.	290	L.F.	210.00	60,900	
	Subtotal				<u>17,437,500</u>	
	Contingencies				3,764,500	
	Total, Federal construction cost					\$21,000,000
	Engineering and Design					2,500,000
	Supervision and Administration					<u>1,500,000</u>
	FEDERAL PROJECT FIRST COST					\$25,000,000

TABLE C-2 (Continued)

Item No.	Item	Quantity	Unit	Unit Price	Subtotal	Total
NON-FEDERAL COST						
A. <u>Lands, easements and rights-of-way</u>						
1.	Lands & improvements				\$ 4,000,000	
	Contingencies				200,000	
	Cost of acquisition				<u>200,000</u>	
	Total, lands, etc.				\$ 4,400,000	
B. <u>Bridge replacement</u>						
1.	Keyes St. 2 lane 34' wide	115	L.F.	\$1,190.00	\$ 136,900	
2.	E. William St. 2 lane 34' wide	150	L.F.	1,190.00	178,500	
3.	E. San Antonio 2 lane 34' wide	200	L.F.	1,190.00	238,000	
4.	E. Santa Clara 2 lane 34' wide	160	L.F.	1,190.00	190,400	
5.	Julian St. 2 lane 34' wide	190	L.F.	1,190.00	226,100	
6.	Mabury Rd. 2 lane 34' wide	330	L.F.	1,190.00	392,700	
7.	Berryessa Rd. 2 lane 34' wide	265	L.F.	1,190.00	315,400	
8.	Oakland Rd. 2 lane 34' wide	295	L.F.	1,190.00	351,100	
9.	Brokaw Rd. 2 lane 34' wide	290	L.F.	1,190.00	345,100	
10.	Trimble Rd. 2 lane 34' wide	300	L.F.	1,190.00	357,000	
11.	Alviso-Milpitas 2 lane 34' wide	536	L.F.	1,190.00	636,800	
12.	Dixon Rd. 2 lane 34' wide	544	L.F.	1,190.00	647,400	
	<u>Subtotal</u>				<u>4,019,000</u>	
	Contingencies				781,000	
	Subtotal, bridge replacement				\$ 4,800,000	
	Engineering & Design, Supervision & Administration				<u>800,000</u>	
	Total, bridge replacement					\$ 5,600,000
	Total, non-Federal project cost					<u>\$10,000,000</u>
	TOTAL, PROJECT FIRST COST					\$35,000,000

ESTIMATES OF ANNUAL CHARGES

C-7. INTEREST RATE

The 3-1/4 percent rate of interest for both Federal and non-Federal financing, used in this report is based upon the average rate of interest-bearing securities of the United States at the present time and is in accordance with the advice from the U.S. Bureau of the Budget.

C-8. INITIAL INVESTMENT

Estimated initial investments for both the Guadalupe River and for Coyote Creek considered improvements are presented in the following tabulation:

<u>Item</u>	<u>Investment</u>	
	Guadalupe River	Coyote Creek
FEDERAL		
Total, Federal investment	\$33,000,000	\$25,000,000
NON-FEDERAL		
Lands and easements	6,600,000	4,400,000
Bridges	<u>2,400,000</u>	<u>5,600,000</u>
Total, non-Federal investment	\$ 9,000,000	\$10,000,000
TOTAL, PROJECT INVESTMENT	\$42,000,000	\$35,000,000

C-9. ANNUAL INTEREST AND AMORTIZATION CHARGES

The computation of annual interest and amortization charges for the considered improvements for the Guadalupe River and Coyote Creek based on a rate of interest of 3-1/4 percent compounded annually and an economic life of 100 years, is given in the following tabulation:

<u>Item</u>	<u>Investment</u>	<u>Annual Factor</u>	<u>Annual Amount</u>
GUADALUPE RIVER			
FEDERAL			
Interest and Amortization	\$33,000,000	0.03388	\$1,100,000
NON-FEDERAL			
Interest and Amortization	\$ 9,000,000	0.03388	\$ 300,000
TOTAL			
Project Annual interest and amortization charges			\$1,400,000

COYOTE CREEK			
FEDERAL			
Interest and Amortization	\$25,000,000	0.03388	\$ 900,000
NON-FEDERAL			
Interest and Amortization	\$10,000,000	0.03388	\$ 300,000
TOTAL			
Project Annual interest and amortization charges			\$1,200,000

C-10. ANNUAL MAINTENANCE, OPERATION AND REPLACEMENT CHARGES

Annual maintenance and operation costs are based on percentages of the first cost of the considered improvements. The percentages are based on experience gained on similar type improvements constructed by the Corps of Engineers. The resulting annual maintenance, operation and replacement charges would then be as follows:

Guadalupe River	\$300,000
Coyote Creek	\$200,000

C-11. SUMMARY OF ANNUAL CHARGES

Economic annual charges for Guadalupe River improvements considered total \$1,700,000, and for Coyote Creek \$1,400,000 comprised of the following items:

<u>Item</u>	<u>Annual Charges</u>	
	GUADALUPE RIVER	COYOTE CREEK
FEDERAL		
Interest and Amortization	\$1,100,000	\$ 900,000
NON-FEDERAL		
Interest and Amortization	\$ 300,000	\$ 300,000
Maintenance, operation and replacement	<u>\$ 300,000</u>	<u>\$ 200,000</u>
TOTAL NON-FEDERAL	\$ 600,000	\$ 500,000
TOTAL PROJECT	\$1,700,000	<u>\$1,400,000</u>

